CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 26 San Francisco, July, 1940 Number 3



86400

STATE OF CALIFORNIA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF FISH AND GAME

San Francisco, California

CULBERT L. OLSON GOVERNOR
RICHARD SACHSE DIRECTOR OF NATURAL RESOURCES

FISH AND GAME COMMISSION

NATE MILNOR, President Los Angeles
GERMAIN BULCKE, Commissioner San Francisco
EDWIN L. CARTY, Commissioner Oxnard
W. B. WILLIAMS, Commissioner Alturas
LEE F. PAYNE, Commissioner Los Angeles

BUREAU OF FISH CONSERVATION

A. C. TAFT, Chief San Francisco
A. E. Burghduff, Supervisor of Fish Hatcheries San Francisco
L. Phillips, Hatchery Inspector San Francisco
Earl Leitritz, Foreman Mt. Shasta Hatchery Mt. Shasta
Geo. McCloud, Superintendent Mt. Whitney Hatchery Independence
D. A. Clanton, Superintendent Forest Home Hatchery Forest Home
J. C. Lewis, Superintendent Tahoe Hatchery Tahoe
Ed Clessen, Foreman Fort Seward Hatchery Alderpoint
William Berrian, Foreman Fall Creek Hatchery Copco
Archie Thompson, Foreman Yosemite Hatchery Yosemite
John Marshall, Foreman Feather River Hatchery Clio
R. A. McCloud, Foreman Kaweah Hatchery Three Rivers
Donald Evins, Foreman Lake Almanor Hatchery Westwood
H. E. Cole, Foreman Basin Creek Hatchery Tuolumne
Peter Topp, Foreman Burney Creek Hatchery Burney
C. L. Frame, Foreman Kings River Hatchery Fresno
Allan Pollitt, Foreman Prairie Creek Hatchery Orick
J. L. Stinnett, Foreman Brookdale Hatchery Brookdale
Merrill Brown, Foreman Central Valleys Hatchery and Fish Rescue Elk Grove
G. C. Tabler, Fish Hatchery Man, Yuba River Hatchery Camptonville
Clarence Chansler, Fish Hatchery Man, Madera Hatchery Bass Lake
Harold Hewitt, Fish Hatchery Man, Alpine Hatchery Markleeville
R. C. Lewis, Fish Hatchery Man, Hot Creek Hatchery Bishop
Joseph Wales, Biological Surveyor Mt. Shasta
Leo Shapovalov, Senior Fisheries Biologist Stanford University
Brian Curtis, Senior Fisheries Biologist Sacramento
William Dill, Senior Fisheries Biologist Fresno
Elden H. Vestal, Junior Fisheries Biologist June Lake
J. W. Cook, Fish Hatchery Construction Estimator San Francisco
E. R. Varnum, Fish Hatchery Construction Estimator San Francisco

BUREAU OF GAME CONSERVATION

J. S. HUNTER, Chief San Francisco
Gordon H. True, Jr., Economic Biologist and Administrative Assistant San Francisco
Donald D. McLean, Economic Biologist San Francisco
Roy M. Wattenbarger, Supervisor Los Banos Refuge Los Banos
L. H. Cloyd, Supervisor Gray Lodge Refuge Gridley
Russell M. Reedy, Supervisor Imperial Refuge Calipatria
Ralph R. Noble, Supervisor Suisun Refuge Joice Island
Joe Vlasnik, Jr., Supervisor Elk Refuge Tupman
John R. Wallace, In Charge, Predatory Animal Control San Francisco
Asa L. Brown, Supervising Trapper Standish
John L. McDonald, Supervising Trapper Weaverville
O. R. Shaw, Supervising Trapper Springville
C. L. Brown, Supervising Trapper Mariposa

BUREAU OF GAME FARMS

AUGUST BADE, Acting Chief Yountville
E. D. Platt, Superintendent Los Serranos Game Farm Chino

BUREAU OF MARINE FISHERIES

S. H. DADO, Assistant and Acting Chief San Francisco
H. B. Nidever, Field Inspector San Francisco

CALIFORNIA STATE FISHERIES LABORATORY

W. L. Scofield, Supervisor Terminal Island
G. H. Clark, Supervising Fisheries Researcher San Francisco
Frances N. Clark, Senior Fisheries Researcher Terminal Island
Harry C. Godsil, Senior Fisheries Researcher San Diego
Donald H. Fry, Jr., Senior Fisheries Researcher Terminal Island
Richard S. Croker, Senior Fisheries Researcher Terminal Island
J. B. Phillips, Senior Fisheries Researcher Pacific Grove
Paul Bonnot, Senior Fisheries Researcher Stanford University
S. Ross Hatton, Senior Fisheries Researcher Stanford University
John F. Janssen, Jr., Senior Fisheries Researcher Terminal Island
Geraldine Conner, Fisheries Statistician Terminal Island

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILDLIFE THROUGH EDUCATION"

VOLUME 26 SAN FRANCISCO, JULY, 1940 Number 3

TABLE OF CONTENTS

Page

California Abalones ---- *Paul Bonnot* 200

The Edible Bivalves of California ---- *Paul Bonnot* 212

The Mammals of Napa County, California ---- *William M. Longhurst* 240

Planting for California Wildlife ---- *A. C. Hawbecker* 271

Death Comes to a Sea Otter ---- *Edna M. Fisher* 278

A Redescription of *Luvarus imperialis* Rafinesque Based Upon a Specimen from Monterey, California ---- *Rolf L. Bolin* 282

Editorials and Notes

Twenty-five Years Ago in "California Fish and Game" ---- *Richard S. Croker* 285

High-powered Engines for Central California Jig Boats ---- *J. B. Phillips* 285

A "Self Canned" Shark ---- *L. E. Herz* 286

Brown Ragfish Taken at Monterey ---- *Rolf L. Bolin* 287

A California Needlefish Recorded at Monterey ---- *J. B. Phillips* 289

Reviews

The Fishes of the Family Sciaenidae (Croakers) of California ---- *W. L. Scofield* 290

Report on Returns of Drift Bottles Released Off Southern California, 1937 ---- *W. L. Scofield* 290

In Memoriam

James H. Vogt ---- *A. C. Taft* 292

Reports ---- 293

CALIFORNIA FISH AND GAME is a publication devoted to the conservation of wildlife. It is published quarterly by the California Division of Fish and Game. All material for publication should be sent to Richard S. Croker, editor, California Division of Fish and Game, Terminal Island, California.

The articles published herein are not copyrighted and may be reproduced in other periodicals, provided due credit is given the California Division of Fish and Game. Editors of newspapers and periodicals are invited to make use of pertinent material.

88400

CALIFORNIA ABALONES [1]

By PAUL BONNOT
Bureau of Marine Fisheries
California Division of Fish and Game

The status of California abalones has been a bone of contention between sport (non-commercial) and commercial fishery interests since the latter part of the last century. The sportsmen's observations have been confined to the littoral zone, the commercial divers' to deep water. The sportsmen contended that the activities of the divers were responsible for the depletion of the abalone population of the beaches. The biologists who have looked into the matter have based their finding on littoral zone observations and information derived from the divers. Little was known of the life-history of the abalone.

In 1913 Edwards published a paper on the California abalone fishery. His observations were made principally at the Japanese abalone camps in Lower California. He went down in a diving suit at least once and reported his observations. Edwards predicted a serious depletion of the abalones in California unless drastic regulations were imposed.

In 1917 Curtner made a study of the abalones in the vicinity of Monterey. He made several descents in a diving suit, and otherwise gathered data to substantiate some proffered details of the life-history and deep water environment of the abalone. He concluded that the regulations then in force gave ample protection to the abalones, and foresaw no danger of serious depletion or extermination.

Several papers on abalones since Curtner's investigations have merely amplified points of nomenclature and geographical distribution, added historical details of the fishery, or noted changes in the fishing methods and regulations.

The green and pink abalones were the main support of the original abalone fishery which was located south of Point Conception and is still carried on to some extent in Lower California. The red abalone, because of its extensive geographical distribution, relative abundance and culinary excellence, is the species which has supported the present commercial fishery for many years. As it is also the species which is hunted most assiduously by the sportsman, it has been the recipient of the preponderance of study and legislative action. The abalone law was inaugurated in 1901 and at almost every subsequent legislature changes and additions have amplified it. (See page 209.) The species of California abalones may be summarized as follows:

[1] Submitted for publication, February, 1940.

Species	Range	Remarks
Red (*Haliotis rufescens*)	Northern California to Mexico.	The commercial species.
Black (*H. cracherodii*)	Pt. Arena to Mexico.	Abundant. Little used.
Corrugated or Pink (*H. corrugata*)	Pt. Conception to Mexico.	Not plentiful in California.
Southern Green (*H. fulgens*)	Pt. Conception to Mexico.	Scarce in California. Taken commercially in Mexico.
Threaded (*H. assimilis*)	Monterey to Mexico.	Rare, deep water form.
Japanese (*H. gigantea*)	Northern California to San Francisco.	Rare.
Northern Green (*H. wallensis*)	Northern California to Pt. Conception.	Small, rare.

It has been a difficult matter for the biologist to investigate the abalone in deep water. Diving is a specialized form of fishing. Information derived from one or two descents in a diving suit does not give a sufficient background upon which to base any very pertinent conclusions. The average commercial abalone diver, in common with other commercial fishermen, is an unreliable source of information, simply because he is not a trained observer and manifests little interest in environmental and ecological conditions affecting even those species in which he is primarily interested.

During the summer of 1939, T. D. Reviea, a commercial abalone diver at Morro Bay wrote the Division of Fish and Game regarding his observations of the abalones and the ecological conditions pertaining to them. He suggested that a Division biologist be detailed to check and amplify his findings. In passing, it may be noted that Reviea proved to be an accurate observer and a capital diving instructor.

Several trips to Monterey and Morro and contacts with the divers contributed materially to previous information pertaining to the abalone fishery. The divers indicated the various localities in the open territory where abalones were found, together with their ideas of the relative abundance in each situation. The designated areas were embodied in a large scale chart to be used as a guide to a proposed diving program. It was during these negotiations that the industry was requested to offer suggestions for the regulations authorized by the new amendment to the abalone law. (See page 210.) A contract was made with Reviea for his services, together with those of his crew and the use of his diving equipment. Diving was begun on October 10, 1939, and continued, when weather conditions permitted, until November 2. The area examined was from Monterey to San Miguel Island. Thirty-four dives were made and some 16½ hours spent on the bottom at depths which varied from twenty to one hundred feet.

Some form of approximate census was originally intended but the first few descents demonstrated the impracticability of any such possibility. The configuration of the inshore sea bottom is extremely broken and rugged. The predominating feature consists of irregular masses of rock of varied sizes which assume any angle from horizontal to vertical. The irregular nature of the terrain and the even diffusion of the dim light precludes any attempt to travel in a straight line without special equipment. The abalone population is distributed

irregularly, dependent on a diversity of ecological conditions. Under the circumstances it was not feasible to make any detailed counts.

Written notes of underwater observations were recorded as soon as possible in order to establish details. A comprehensive idea of the



FIG. 77. Diving boat used in abalone investigations, October, 1939.

present abalone population and the environment in which it lives, was obtained.

Abalones are found on rocky bottoms from the low tide line to an undetermined depth. There are vast numbers of them out to the 60-foot level. From 60 to 80 feet there is a gradual decrease in numbers and at 100 feet only a few are found in unusually favorable places, a condition which is said to continue to greater depths. The divers ordinarily work out to 80 feet. Only occasionally do they endeavor to work at greater depths. From the shore line to the 80-foot level in the territory surveyed, there are great numbers of abalones with shells that measure from six to eight inches in diameter. Comparatively few are eight inches or larger (eight inches is the legal minimum size limit). This is a logical sequence in territory systematically worked by the divers.

There are a few five-inch and still fewer four-inch abalones, and below four inches none at all, except in one or two areas where special conditions prevail. The absence of the small sizes constitutes a serious condition. As the six- and seven-inch abalones reach eight inches and are taken by the divers, there will be no younger age classes to replace them.

In Pebble Beach Cove on the northern side of Carmel Bay, an area was found which can be considered virgin territory. No commercial diving has been permitted here for twenty years. There are great quantities of abalones, ranging in size from ten inches in diameter to tiny shells of one millimeter (1/25 inch). A series of

living abalones was collected from the outside surface of a large, dead abalone shell found in 40 feet of water, which range in size from one to three mm. (1/25 to 1/8 inch). No one has ever collected abalones on this coast even approaching this size before and the acquisitions of these specimens is a real advance in the study of the life-history.

The lack of small abalones in most of the area surveyed coincides with the absence of old abalone shells. Very few large abalones are given an opportunity to die of old age by the divers. It is possible that the old abalone shell is a necessary adjunct to the successful development of the young stages. This supposition will be tested experimentally and if found to be valid, it will be a simple matter to remedy the condition by requiring the divers to return the shell from their catches after the packing houses have processed the animals. No financial loss would be involved by such a regulation as the shell has no present commercial value. There are tons of shells piled up at Monterey and Morro Bay.

The littoral zone along the entire California coast, which until quite recently was populated by vast numbers of abalones, has today practically none at all. The divers have been blamed for this state of affairs because of the erroneous impression that abalones will move inshore to repopulate territory denuded by natural or human agencies. Abalones move about very little, and they do not voluntarily move in from deep water. The littoral zone is the abalone ground of the sports-



FIG. 78. The author starting to descend during the course of the abalone survey, October, 1939.

man (noncommercial gatherer) and is not molested by the commercial man. In deep water, the hunting ground of the diver, there are thousands of dozens of abalones of the eight-inch legal size and many times that number below eight inches. Littoral zone areas where no com-

mercial diving has ever been carried on, are in the same condition as those adjacent to diving territory. The disappearance of the abalones can not be laid to the divers.

It was suggested a number of years ago that young abalones might be found in rock crevices in the lower littoral zone. To check this in connection with the present investigation, Moss Beach (near Half Moon Bay) and Pebble Beach Cove (on Carmel Bay) were examined. It may be stated at once that no small red abalones were found. At Pebble Beach Cove only two red abalones of six inches were seen. There were many black abalones, ranging in size from one to four inches, inhabiting cracks and crevices in the rock. As the black is a littoral zone form and is not ordinarily found below the low tide line, the presence of comparatively small blacks in this area does not necessarily imply that the young stages of the reds will be found there. The Pebble Beach littoral zone as a whole is in a fairly healthy condition. Access to it is through private property and subject to toll. Comparatively few people use it. Caretakers are maintained in proximity to the cove which evidently effectively curbs over-exploitation.

The Moss Beach area appears to be typical of the California ocean beaches near large centers of population. Twenty years ago the Moss Beach area supported a rich fauna and flora and was considered such a typical example of littoral zone excellence that the science classes of many neighboring schools visited it regularly. Today the area is rapidly becoming a sterile waste. The abalones disappeared some years ago and when one can be found it is some storm transported individual. Sea urchins, once present in vast beds, and "periwinkles" originally represented by tens of thousands have contributed to the gastronomical gratification of a portion of the seashore visitors until sea urchins can be enumerated by dozens, and nine out of ten "periwinkle" shells contain hermit crabs instead of the lawful owner. The rocks have been broken over large areas to obtain the boring clams living therein and the limpets have been taken until one as large as a half-inch is rare. Even the once vast beds of algae are represented only by casual patches of the more tenacious species such as *Fucus*. As the algae is of no value to human beings and was collected only in inconsiderable amounts by science students, its disappearance can only be attributed to the unbalanced condition promoted by the systematic removal of most of the predominating animal forms. Abalones are extremely sensitive to environmental deviations and even though they may have originally utilized the littoral zone as a continuation of their deep water breeding grounds, the present condition of the inshore areas makes it appear extremely unlikely that any of the younger stages will be found there. If the littoral zone is an important part of the brood ground then the activities of the sportsmen may be responsible not only for the absence of an inshore abalone population but may account for the absence of the younger age-classes in deep water.

The methods employed in commercial abalone fishing prior to 1901, when the first regulation was imposed would undoubtedly have resulted in serious depletion, as all sizes were taken and great quantities dried. The regulation forbidding the commercial use of abalones of less than eight inches in diameter effectively curtailed the taking of the young and allowed each individual several spawning seasons before reaching the legal size. The regulations have effectively accomplished the task

for which they were imposed. From 1916 to 1938, inclusive, the commercial divers have landed in California 1,009,786 dozen, or 12,100,412 abalones. During the last ten years of this period (1928-1938) total landings have averaged about 62,000 dozen per year. (See Table 2.) It is possible that for the next year or two this average may fall as the present supply of eight-inch abalones becomes reduced. A period of time will then be necessary to allow the numerous six- and seven-inch classes to enter the fishery.

Biologists and administrators entrusted with the care of natural resources continually stress the idea that a resource can be *managed* in contradistinction to exploited. To properly manage a resource, detailed knowledge is of course essential. In the past, many regulations for the utilization of natural resources have been imposed with an insufficient background of knowledge in the hope that they would remedy a condition which was, or was thought to be, unsatisfactory. Some of these regulations have been beneficial, some have not. The abalone fishery has been fortunate in respect to the regulations imposed upon it. Many were based on probable biological assumptions, the only available criterion, others merely on lay opinion. Although the effectiveness of some of them is of doubtful virtue, in the aggregate they have been of benefit to the resource. With steadily accumulating biological and statistical information, fallacious regulations can be discarded and competent ones substituted.

Life-History Notes

Although the abalone is a very primitive form which has weathered the vicissitudes of changing conditions for millions of years, it is so delicately adjusted to its present environment that attempts at any form of confinement or artificial manipulation are fatal in a short time.

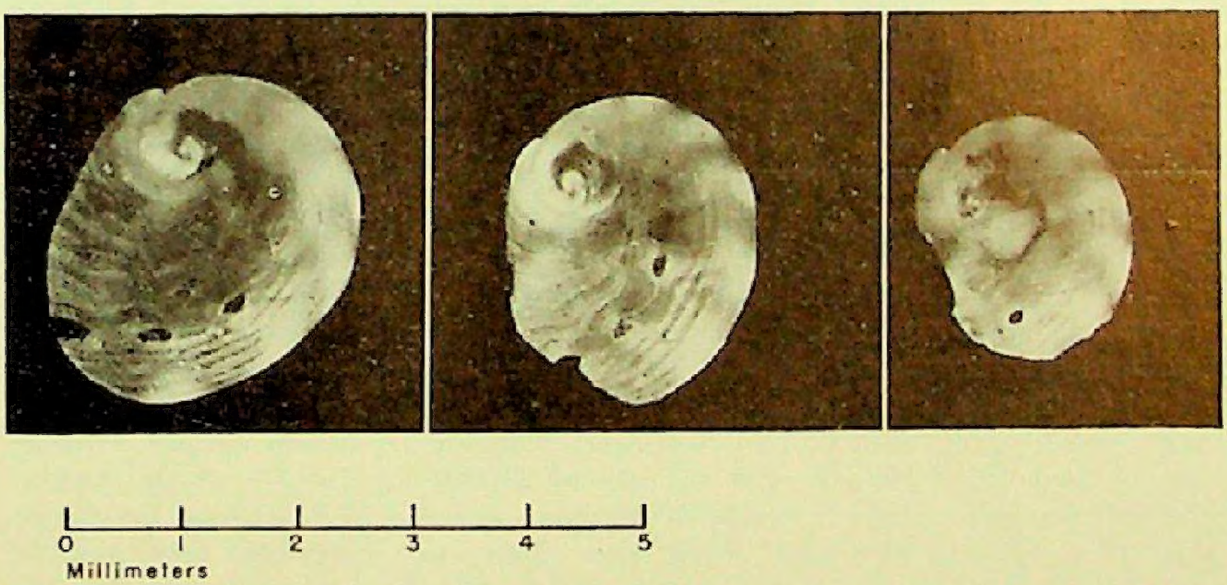


FIG. 79. Young abalones taken from an abalone shell in 40 feet of water in Carmel Bay, October, 1939. Photograph by Paul Bonnot.

For this reason very little is known of the life-history. Curtner (1917) is the only research worker who has reported any details of the spawning and growth of the abalone. His findings were primarily based on observations made in the littoral zone and from analogy. He assumes

that the abalone has a free-swimming stage because there are other gastropods that do. Some forms of gastropods, however, do not have swimming larvae; the predacious drills are an instance. At the apex of the small shells taken at Carmel Bay, the larval shell is plainly visible (see Fig. 79). It has the appearance of a U-shaped worm tube and may indicate that the larva as well as the adult is a creeping bottom form.

Curtner gives a table of correlations between age and size. He marked 300 abalones and released them. Thirteen months later he recovered three of the marked specimens and measured the growth of the shell. From the increase shown he derives yearly growth rings and gives a correlation between age and size beginning with a one-year abalone of 1.2 inches in diameter and ending with one 13 years old and 8.0 inches. From gonad examinations he came to the conclusion that spawning occurs in February and March. The finding of abalones with shells from one to three mm. (1/25 to 1/8 inch) during October raises a question as to the spawning time or yearly growth or both. Many mollusks grow rapidly for the first season or two, sometimes attaining two-thirds of the normal adult size and bulk during that period. As the small abalones were all taken from the same shell, there is no question of environmental differences and the conclusion must be that they were spawned at different times during the 1939 season.

Notes on Diving

The first few dives made by an amateur are chiefly devoted to gaining experience in handling an unfamiliar type of gear in a foreign element. To move about under water without undue labor and fatigue requires practice, and adjustments to changing pressures must be considered and applied. Although assured that it is perfectly safe, the assurance has generally been somewhat minimized by anecdotes relating to the death of a diver who had his air and life lines cut by the boat propellor or of so-and-so who lost his air at eighty feet and had to be forcibly pried out of his helmet. Cheerful reflections with eighty feet of dim green water overhead, but the gurgling rush of air from the escape valve continues and in a short time, so adaptable is the human mind and body, that going down to sixty or eighty feet raises the blood pressure no more than going for a walk around the block.

In the area inhabited by the abalones, the inshore sea bottom is composed largely of rock, either in vast flat surfaces, intersected by cracks of varying widths and depths, or in broken and upheaved masses forming great straight-sided peaks and valleys. The bottoms of the large cracks and valleys are carpeted with clean white sand. On the flat surfaces of rock are vast forests of algae. A jungle of the perennial *Pterygophora* is everywhere between the 40- and 80-foot levels, its palm-like fronds swaying with the changing currents. In broken ground *Pterygophora* is not so plentiful and is interspersed with the annual bull kelp (*Nereocystis*) and pea kelp (*Macrocystis*). Sometimes the hold-fasts of the bull kelp are fastened to the stout stems of *Pterygophora*.

Surface swell action continues to the bottom, becoming gradually weaker with depth, although at 100 feet it is still to be reckoned with. There are no sharp points or angles as the substratum is everywhere rounded and water worn. Nearly all of the animal forms prefer slant-

ing or vertical surfaces on which to live. Abalones, barnacles and anemones are seldom found on a horizontal surface. Coralines and sea urchins are indifferent to the angle of the substratum. The sea urchins hold a continual menace for the diver especially when a strong current is throwing him about. Sea urchin spines make nasty wounds in hands and go through the diving suit with ease; they are an uncomfortable but sometimes compulsory seat, and contact with them not only annoys the occupant of the diving suit but necessitates a blow-out patch to prevent water leaking in.

Everything appears magnified under water and distances are deceptive. A four-inch abalone seems as large as a wash tub until the shell is spanned by the fingers. A shell or other object apparently two feet away will be found out of arm's reach. Another diver looms ten feet high and wide in proportion.

In the upper levels where sunlight penetrates easily, the landscape, or seascape, presents a picture of bright colors and teeming life. Slanting shafts of glowing, diffused light produce dancing shadows. Fish swim about the diver indifferent to his presence. Flatfish scuttle across a sandy patch and vanish as they come to rest, so closely does their coloring resemble the background. Gobies slide across the rocks and occasionally endeavor to nibble a white glove evidently under the impression that it is edible. Schools of tiny fish, so minute they give the impression of a cloud of gnats, float past. On the surrounding rocks, huge variously colored anemones wave their tentacles expectantly. Gastropod shells leap about agilely and in an altogether ungastropodal manner of progression which is puzzling until they are captured and the hermit crab inhabitant discovered. Starfish and sea urchins are everywhere, and all about red, green and brown algae sway and swing to the water currents. The sub-littoral sea bottom is an altogether instructive and beautiful region.

As the depth increases, the fauna and flora change. Species gradually disappear until at 100 feet only the more hardy or adaptable forms remain. There is a surprising amount of light at 100 feet; nevertheless the impression is one of twilight and gloom. In contrast to the bright, teeming upper levels, desert conditions prevail.

From the tide line to the depth of 100 feet, the area comprising the ocean bottom and the overlying water is one of the most savage environments to be found on the earth. Both animal forms and plant life inhabiting this region must maintain a perfect physical condition as the smallest blemish, the least impotence, marks the individual for prompt and inevitable elimination. It is in this setting that the abalone diver pursues his calling.

Abalone diving requires more physical stamina than any other mode of present day fishing. Aside from the ever-present contingency of accident that may kill or permanently injure the diver, the conditions under which he is forced to labor drain the vitality much more rapidly than comparable activity elsewhere. Even the divers who work the underwater details of bridges, pipe lines or ships have a distinct advantage, as their scene of activity is usually within a small area, they dive from barges with elaborate equipment and abundance of help and they work under water for stated times at definite depths. The abalone diver goes down at what he considers a favorable place and starts traveling. He may stay on the bottom from one to four or five

hours, traveling a mile or more over rough country and in depths that may vary from 30 to 80 feet, sending up in the course of his wanderings from one to two tons of abalones. When he comes up tired and hungry about the only thing he can eat or drink for a couple of hours is coffee, orange juice or a spoonful of honey, as anything substantial would in all probability double him up with the bends. It is not surprising that divers are sometimes short tempered. A dive of four or five hours occasionally makes a diver temporarily light-headed. This account can well be closed with a true story which illustrates nicely the attitude of the abalone diver to his vocation.

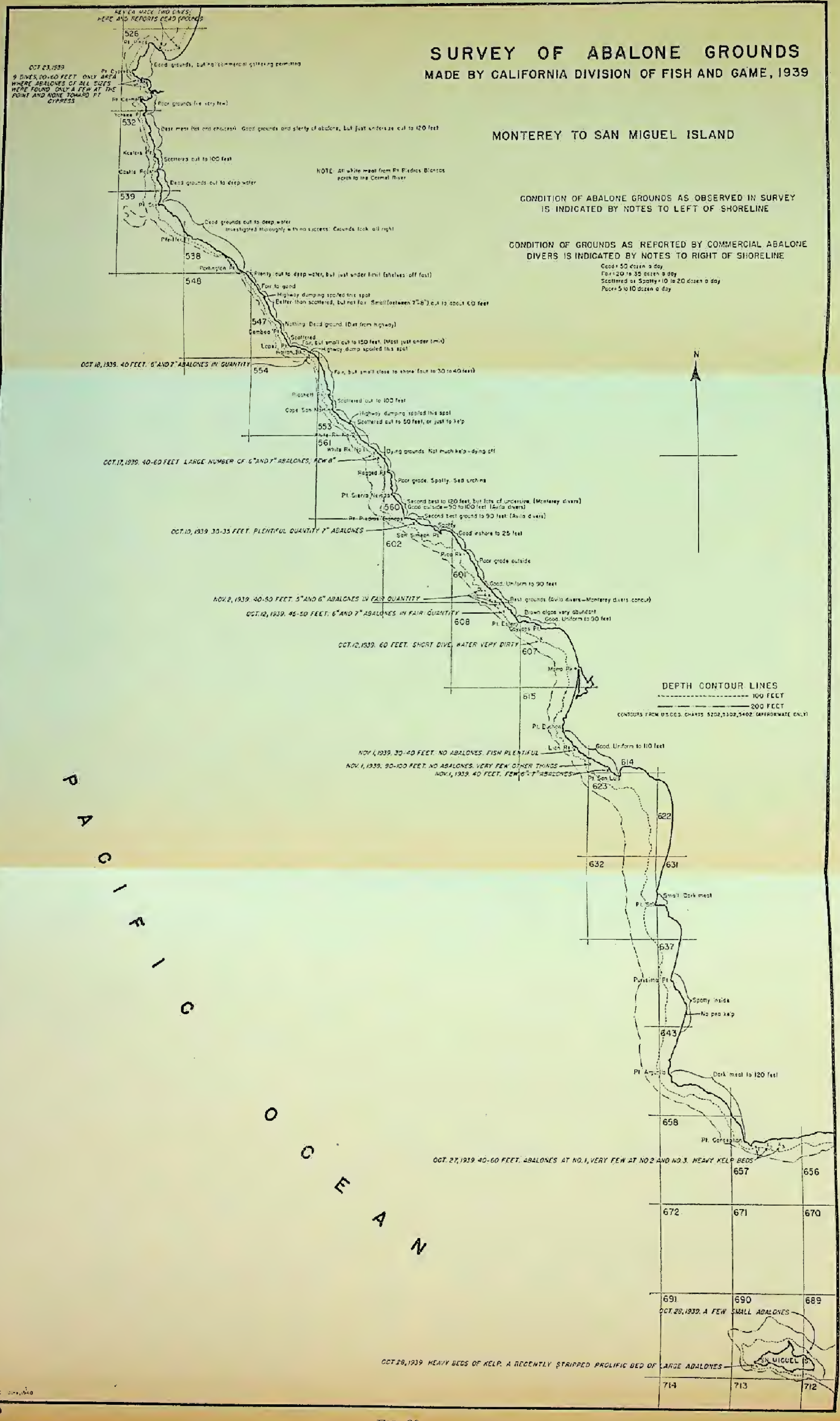
Not so long ago one of the Morro Bay divers took a vacationing friend on one of his trips. When the diver is up, standing on the ladder having a smoke between dives, the glass plate which screws into the front of the helmet is kept in a bucket of sea water. Between dives the diver's friend, trying to be helpful, decided they needed some new water and dumped the old overboard, face plate and all. It was early in the day and, while another face plate could be ordered, the day's fishing and possibly the next two or three would have been lost, so the diver decided he could retrieve and use the original one. From an old life preserver the crew cut a circular piece of cork, fitted it into the face plate hole, tied it with a piece of wire and the diver went down and retrieved his face plate in 45 feet of water, using the helmet's side windows. And that particular diver has never shown any leaning toward suicide.

TABLE 1

Record of Diving Between Monterey and Point Conception, October 10, 1939-November 2, 1939*

Date	Place	No. dives	Depths feet	Time on bottom	Remarks
10/10/39	Between Piedras Blancas and San Simeon	2	30–35	1 hr.	Rock and sand bottom. *Pterygophora* plentiful. Fair quantity 7" abalones.
10/12/39	North side, Pt. Estero	1	45–50	½ hr.	Heavy beds of *Pterygophora*. Heavy swell and water very dirty. Hard time to stay on the bottom.
	Off Cayucos Pt.	1	60	¼ hr.	Bottom sandy. Heavy swell and too roily to see anything.
10/17/39	South White Rock No. 1	3	40–60	1½ hr.	Large number 6" and 7" abalones, a few 8". Everything dirty with silt from road work.
10/18/39	South Harlan Rock	3	40	1½ hr.	6" and 7" abalones in fair quantity.
10/23/39	North side, Carmel Bay	9	20–60	3 hr.	Virgin ground. All sizes abalones in considerable quantity.
10/27/39	South side, Pt. Conception	3	40–60	1½ hr.	Abalones on the point. South very little. Heavy beds of *Macrocystis*.
10/28/39	Northeast side, San Miguel Island	2	30	2 hr.	No swell, clear water, little algae. A few very small abalones.
	Southwest side, San Miguel Island	3	40–60	1 hr.	A very few 4"-5" abalones. Numerous scars where some diver has removed all the big ones.
11/ 1/39	North side, Pt. San Luis	1	40	½ hr.	Fair number 6" and 7" abalones.
	5 miles north Pt. San Luis	1	90–100	⅛ hr.	No abalones. Very few other things. Very dim and cold.
	Lee of Lion Rock	1	30–40	½ hr.	Deep rocky valley. Algae scarce. No abalones. Fish plentiful. Starfish plentiful.
11/ 2/39	5 miles north Pt. Estero	4	40–80	3 hr.	Took bottom sample with a tow net, sample all copepods. 5" and 6" abalones in quantity. Heavy bed o bull kelp here.
		34		16 hrs., 35 min.	

* This is a record of the diving of the Division's biologist. Both divers were down on many dives but some were made solo by the biologist. Reviea made several dives in Monterey Bay in addition to those noted above. (See map, Fig. 80.)



88400

Pages 208-209

FIG. 80

The Evolution of the California Abalone Law

The first legal recognition of abalones appears in the California penal code (sec. 628) in 1901 and at almost every subsequent legislature there have been changes and additions. It is of interest to note the changes in the dates of closed seasons as ideas regarding the breeding period fluctuated. In the following notes the important additions are recorded:

1901. No abalones to be taken or possessed of less than 15 inches in circumference.

1905. No black abalones to be taken or possessed of less than 12 inches in circumference.

1907. No diving permitted.

1909. No red abalones to be taken of less than 17 inches in circumference.

1911. Closed season:
March 1–July 1.

Minimum sizes:
red, 17 inches circumference
green, 16 inches circumference
pink, 14 inches circumference
black, 12 inches circumference
Illegal to use for other than food or to bring ashore dead or out of the shell.

1913. Closed season:
February 1–April 30.

Minimum sizes:
red, 19 inches circumference
green, 18 inches circumference
pink, 16 inches circumference
black, 14 inches circumference
Illegal to ship out of state or to use spears.
In district 6, diving illegal.
Illegal to take black abalones in district 6.
Bag limit of 10 per day.

1915–17. Illegal to dry any abalones.

1917–19. Closed season:
red, February 1 to last day of February.
other species, February 1–April 30.

Minimum sizes:
red, 7 inches diameter
green, 6½ inches diameter
black, 5 inches diameter
Diving illegal in districts 17, 19, 20.
Districts 4, 19: limit 10 per day, 20 per week.
Out of state abalones imported under regulations.

1919–21. Minimum size:
pink, 6 inches diameter.

1921–23. Closed season: January 15–March 15.
Limit: 10 per day, 20 per week in districts 15, 16, 17, 19, 20, 20a.
Diving illegal in districts 17, 19, 20, 20a.
Districts 10, 18 (high water to 20 feet), limit 10 per day, commercial size 8 inches minimum.
Closed commercial district, Pt. Buchon to mouth of Pico Creek.

1925–27. Diving illegal in districts 15, 16, 17, 19, 20, 20a.

The gradual accumulation of the above noted contributions to the legal status of the abalone has resulted in the present law, as of 1939. Stripped of legal verbiage and repetitions it may be summarized as follows:

Open season: March 16–January 14.

Minimum sizes:

Sport: red, 7 inches diameter
green, 6½ inches diameter
pink, 6 inches diameter
black, 5 inches diameter

Commercial: red, 8 inches diameter (districts 7, 10, 18).

Bag limits:

District 2: 5 per day and possession (except markets).
District 2½: 10 per day and possession (except markets).
Districts 7, 15, 16, 17, 19, 20, 20a: 10 per day and possession, 20 per week. (Limit not applicable in districts 15, 16, 17 to outside abalones brought in.)
District 18: 10 in the aggregate per day, all species, from shore.
District 10: 5 in the aggregate per day, all species, from shore.
Districts 15, 16, 17, 18, 19, 20, 20a, 21: 10 black per day.
Diving for abalones legal in district 18 in more than 20 feet of water.
Legally taken, sliced abalone may be kept in closed season (under regulations).
Illegal to bring ashore dead or detached from the shell.
Must be taken solely for food and may not be dried.
Illegal to export shell or meat from state.
Illegal to use spears to take abalones.
Legal to import abalones that conform to legal sizes.
Sport fishing license required to take abalones.

The 1939 legislature added section 802.7 (ch. 1123, stats. 1939) which reads as follows: "Abalones may not be taken for commercial purposes except under a permit issued by the commission. The commission may grant a revocable permit to take abalones for commercial purposes under such restrictions, rules or regulations as the commission may prescribe."

Under the authority conferred by this provision, the Bureau of Marine Fisheries of the Division of Fish and Game, after receiving suggestions and the concurrence of the industry has issued the following regulations, subject to future changes or additions:

"1. Every abalone diver shall carry a measuring device so that he may be able to measure all abalones before prying or lifting the abalone from its place of attachment. If any abalones under eight (8) inches in greatest diameter are accidentally detached by the diver, he must immediately replace such undersize abalones on the rocks from where they were taken.

"2. No red abalones under eight (8) inches in greatest diameter shall be sent to the surface of the water by divers or crews, nor shall any abalones less than eight (8) inches in greatest diameter be taken or possessed at any time. And further provided that in the event darkmeated abalone that reach the boat are not usable, they shall be put back into the basket and returned to the diver who shall see that they are placed on the rocks and they shall not be thrown overboard from the boat.

"3. No abalones shall be taken from the shell or be possessed out of the shell on any boat, barge or pier, or before they are delivered ashore to a plant provided with a State wholesale shellfish dealer's license.

"4. No person who operates under an abalone permit and uses diving apparatus is permitted to dive in water less than twenty (20) feet in depth in any district at any time except when employed or engaged in diving work *not* connected with gathering or taking any type of sea life.

"5. All diving tenders and boats used in diving for abalones, except mother vessels from which diving tenders work, shall carry on the exposed part of the hull or on the superstructure amidships on each side of the boat, the number of the owner's permit, in ten (10) inch black numbers on a white background.

"Permits shall not be assigned or transferred, and any right or privilege granted thereunder is subject to revocation, without notice, by the Board of Fish and Game Commissioners at any time."

Permits are being issued to take red abalones for commercial purposes in District 18 only. All permits already granted expire on March 31, 1940, and new permits will have to be secured effective April 1, 1940.

TABLE 2

Commercial Abalone Landings in California[a]

Year	County						
	Del Norte-Humboldt	Mendocino-Sonoma	Marin-San Francisco	Monterey	San Luis Obispo-Santa Barbara-Ventura	Los Angeles	Total pounds
1926				2,043,023	17,747		2,060,770
1927	86,000			2,712,445	18,085		2,816,530
1928				2,049,875	16,368		2,066,243
1929		8,751		3,412,460	17,647		3,438,858
1930				3,158,975	17,538		3,176,513
1931				3,210,825	51,341		3,262,166
1932		123		2,135,375	681,805	42	2,817,345
1933				2,221,500	534,688		2,756,188
1934				2,786,775	435,500	1,217	3,223,492
1935		17,225	550	2,656,200	1,195,975	971	3,870,921
1936		23,067	10,600	1,575,075	1,692,143	710	3,302,195
1937				1,433,200	1,428,247	1,728	2,863,175
1938				1,203,050	909,908	7,010	2,121,468
Total pounds	86,000	49,166	11,150	30,600,278	7,016,992	12,278	[b]37,775,864

[a] Compiled by Bureau of Marine Fisheries. Includes catches made off the California coast only.
[b] This total is equivalent to 9,066,294 abalones, or 755,517 dozens of abalones. This amounts to an average of 62,060 dozen a year.

References

Bonnot, Paul

1930. Abalones in California. California Fish and Game, vol. 16, pp. 15-23, 6 figs.

Croker, Richard S.

1931. Abalones. California Division of Fish and Game. Fish Bulletin, no. 30, pp. 58-72, 5 figs.

Curtner, W. W.

1917. Observations on the growth and habits of the red and black abalones. Master's thesis, Stanford University.

Edwards, C. L.

1913. The abalone industry of California. California Fish and Game Commission. Fish Bulletin, no. 1, pp. 5-15, 3 figs.

Phillips, J. B.

1937. Abalone. California Division of Fish and Game. Fish Bulletin, no. 49, pp. 107-113, 3 figs.

Scofield, N. B.

1928. Abalone safe from extermination. California Fish and Game, vol. 14, p. 87.

1930. Conservation laws provide ample protection for abalones. California Fish and Game, vol. 16, pp. 13-15.

THE EDIBLE BIVALVES OF CALIFORNIA

By Paul Bonnot
Bureau of Marine Fisheries
California Division of Fish and Game

Drawings by Hester Bonnot

Comparatively few of the many species of West Coast clams, mussels and scallops attain enough size or occur in sufficient quantity to bring them to the serious attention of vacationists and campers. However, the situations in which these species may be found and their varied modes of life, which adapt them to their own specialized environments, offer an extensive choice to the interest of sea-shore visitors. Mussels may be gathered in quantity from the wave-washed rocks of the outer coast; the Pismo and razor clams are dug from flat, sandy beaches under the surf line by those rugged individuals who make light of a drenching and a risk of pneumonia in the winter months, while many species of proven gastronomical excellence flourish in the mud flats of sheltered bays, where many people of a more sedentary and contemplative nature can obtain them with a minimum of discomfort and exertion.

The species treated in the present paper are those most likely to be encountered by campers and vacationists. No effort has been made to give more than the easily recognized external characters and such internal processes as are unusually prominent. Although all the included forms are edible, some will find more favor than others, depending on abundance, the effort required to gather them, and culinary preparation.

Although the clams and mussels described in this article are all good to eat, it must be remembered that at certain seasons those found along the open coast are apt to be poisonous. In the summer, when the water is discolored red, due to the presence of numberless minute organisms, the bivalves are not safe as food. They feed on these organisms which make their flesh poisonous. Many people have lost their lives or become ill from eating mussels and clams which had fed on "red water." The illness is known as "mussel poisoning" although it can be contracted from other bivalves. The State Board of Health announces every season the times when it is safe to eat mussels and clams gathered along the coast. Apparently, clams found in bays or estuaries are not seriously affected.

The bivalves demonstrate a surprising amount of activity, although considered by many as sluggish, unresponsive forms. The scallop, by clapping the valves together, "swims" in a jerky fashion, the razor and jackknife clams dig and burrow energetically through the mud and sand in which they live, and the borers by slow rotating movements hollow their abodes in stiff clay or soft rock.

As the name bivalve indicates, these mollusks are covered by two valves or shells which are hinged together on one edge. The rounded or pointed part of the shell in the hinge area is called the umbo. The hinge, in some cases, consists merely of two smooth surfaces; in others, of a fairly intricate arrangement of interlocking teeth, with accessory plates and bosses. A strong elastic ligament holds the two valves together at the hinge and exerts sufficient pressure to hold them partly open. The action of the ligament is counteracted by one or two muscles which close the shell. The body of the animal lies in the mantle which fits snugly against the inside of the shell. The mantle can be compared to a folded sheet of paper, closed along the hinge side and open around the other edges. The open edges of the mantle are sometimes fused together in one or more places. Glands in the outer edge of the mantle take material from the water with which to build the shell.

Bivalves feed on microscopic animals, plants and particles of inorganic matter suspended in the water. They also obtain oxygen from the water. A more or less constant stream of water passes through the gill chambers, propelled by the beating of cilia, tiny hair-like structures. The current enters the mantle cavity by one tube and is expelled through another. These tubes, known as siphons, may be short and small or very large and long, depending on the type of existence and the size of the animal. In some species the siphons are united; in others, partially or altogether separated. Sometimes referred to as the "neck," the siphons are situated at the posterior end of the body, the "head" being at the opposite or anterior end.

The muscle or muscles leave scars on the inner surfaces of the valves, which are sometimes characteristic of the species. As the animal grows, the muscles migrate outward, leaving an increasingly prominent trail. The two muscles are known as the anterior adductor and the posterior adductor. Where only a single muscle is present, it is the posterior adductor.

The outside surfaces of the valves are marked with concentric ridges or radiating lines. In some cases both are present. The concentric lines can sometimes be used for age determination but are not always a reliable index. A distinct "ring" caused by the bunching of a number of the lines may mean a slowing up of growth during the cold weather of winter, or may merely indicate some passing unfavorable condition. The valves are covered by a transparent "skin" or periostracum. It is sometimes thick and brightly colored, sometimes so thin and colorless as to pass unnoticed. The periostracum is not renewed and on many large shells it may be worn away in the region of the umbo.

The digging and burrowing of bivalves is performed by the foot. This is a prominent flattened muscular appendage which is thrust into the sand or mud and expanded at the tip by filling it with body fluid. After the tip is thus firmly anchored, muscular contractions of the foot draw the animal through the substratum. Some forms have a large well-developed foot and can move about actively. In others of more sedentary habits, the foot is inconspicuous.

The rate of growth of bivalves is determined primarily by the amount of food they are able to gather. In a backwater where the current is sluggish, they grow slowly, whereas in an exposed area sub-

jected to a swift, strong current they will make rapid growth. Most of the bivalves under favorable conditions do most of their growing during the first eighteen months of their existence. They continue to grow during their whole life but growth is much slower after the first two years. Most of them reach sexual maturity at the end of three years, though some species breed sooner and individuals do not always conform to any set time. Some clams are long-lived, such as the rock cockle (*Paphia*) that lives to be 6 or 7 years old and the Washington clam that sometimes reaches an age of 16 or 17 years.

To gather bivalves requires little or no equipment. Mussels may be pulled from their rocky supports with the hands, aided when necessary by a tire iron or an old automobile spring leaf. Most species of bay clams are dug with a shovel, others may be picked up on the surface. In a soft mud bottom a clam hook is sometimes used. This is merely an L-shaped iron rod which is pushed down into the open burrow of the clam and given a half or quarter turn and pulled up. Clam hooks are used extensively for securing fast-moving forms such as the jackknife. Pismo clams lie close to the surface and are usually taken by probing with a pitch fork or by pulling a four- or five-tined potato fork through the sand. To sink the tines, the digger puts the end of the handle of the fork on one shoulder, bears down on the center of it with his hands and walks slowly backward.

Native Oyster

Ostrea lurida

Description. Valves irregular in shape, circular or elongated, sometimes scalloped at the edges, dark gray or blackish. Under valve (left) cupped, upper flat. Seldom exceeds 2 inches.

Habitat and Range. The native oyster is found in most inlets and bays from Alaska to Lower California, attached to the shells of previous generations of oysters or any firm surface which will hold them out of the mud. A natural bed may consist of half a dozen individuals or may cover many acres, and will be found between the channel bottoms and on mud flats at about the three-foot tide level.

Notes. Although abundant in some California bays and inlets, the local wild oysters are little used, as they are generally of small size or have misshapen valves due to crowding with the attendant competition for food and growing space. Wild native oysters are very good to eat and because of their small size are generally consumed raw. In gathering them, discretion is necessary as many wild oyster beds flourish in close proximity to sewer outlets. The oysters marketed in California under the trade name of "Olympias" are cultivated native oysters from Puget Sound. At the present time, the California Division of Fish and Game is carrying on a program of commercial oyster growing, and some measure of success has been already attained in producing native oysters acceptable to the market. The commercial beds are located only in clean areas, and the oysters from them are periodically tested and certified by local and State health authorities.

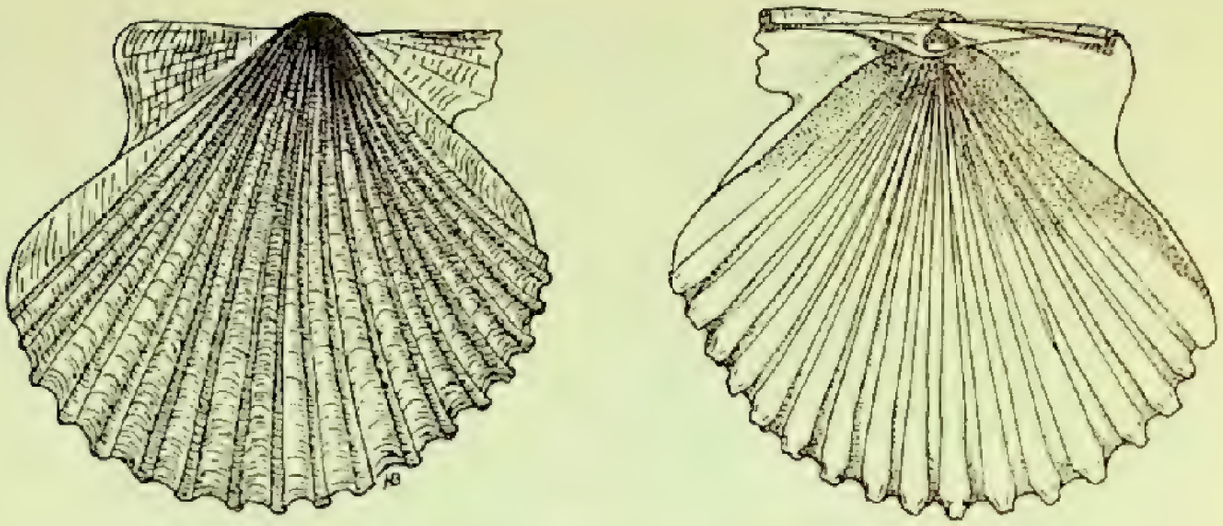


FIG. 81. Scallop, *Pecten circularis acquisulcatus;* actual size.

Scallop

Pecten circularis acquisulcatus

Description. Rounded valves with wing-like lateral projections on each side of the umbo. Radiating ribs and grooves which alternate and interlock at the edges with those of the opposite valve. Foot small, one muscle. Flesh yellowish, tinged with orange or red. The edge of the mantle is supplied with tiny eye spots (ocelli) which readily distinguish light and shadow. Size up to 3¾ inches.

Habitat and Range. This scallop lives on the surface of sandy bottoms, on beaches, near the entrances of inlets and lagoons, and in bays, from Monterey to Lower California.

Notes. By suddenly snapping the valves together the scallop can progress through the water by a series of jerks. Scallops can be caught in the shallow clear water of the southern lagoons or may be found lying on the sand when the tide is out. The "scallop" which is bought in the markets is the muscle of a large species which is found on the New England coast and in British Columbia and Alaska. Only the muscle is used for food and the remaining portion of the animal is discarded, an unnecessary waste.

Other Names. Speckled scallop, pecten, fan shell, wing shell, ear shell.

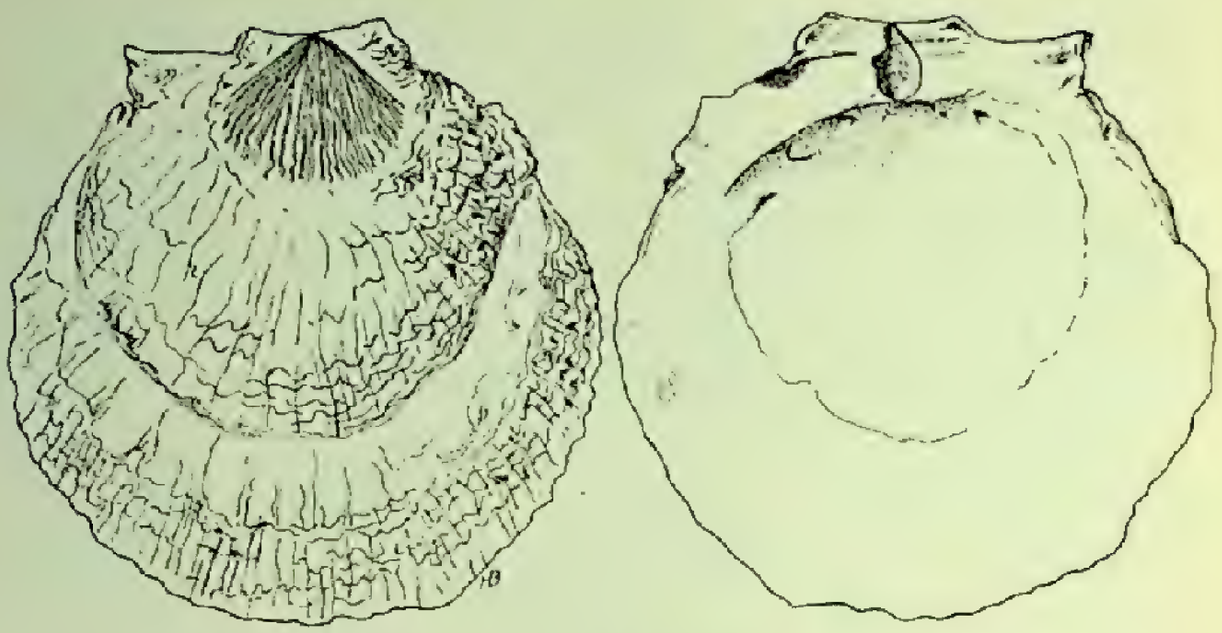


FIG. 82. Rock scallop, *Hinnites giganteus;* four-fifths actual size.

Rock Scallop

Hinnites giganteus

Description. Upper valve heavy and arched, lower flattened. Inner surface of valves white, except for a deep purple area near the hinge. Young stage like other pectens in shape and habits. One muscle. Reaches a diameter of 7 inches.

Habitat and Range. The rock scallop attaches the lower valve to rocks and shells below high tide line on the outer coast in somewhat sheltered places. It is found along the entire coast from Alaska to Lower California.

Notes. After attachment, the rock scallop loses its scallop-like shape and assumes a very rough and irregular surface although the tiny characteristic scallop shell can be seen imbedded at the umbo. They are good to eat and are used locally to some extent, but as they do not occur in sufficient quantities they have little commercial importance.

Other Names. Rock pecten, rock oyster, rock clam.

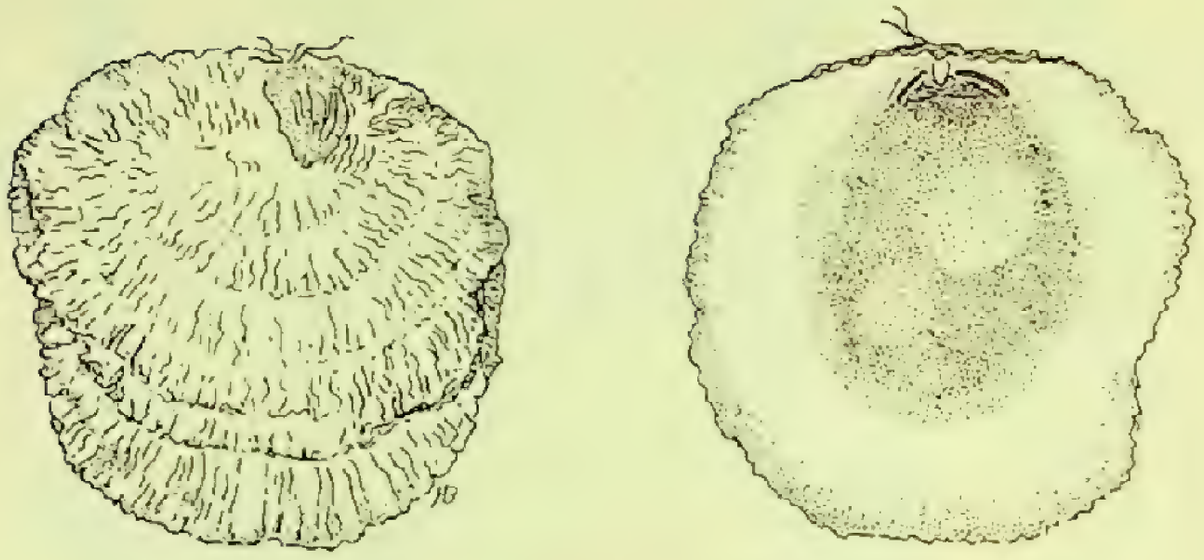


FIG. 83. One of the rock oysters, *Anomia peruviana*; actual size.

Rock Oysters

Anomia peruviana and *Pododesmus macroschismus*

Description. Upper valve white or copper brown outside and bluish green inside. Valves thin and fragile. The lower (right valve) is not fastened to the substratum, but attachment is effected by the byssus which passes through a deep notch in the under valve. The meat of *Pododesmus* is a bright red. The rock oysters attain a size of 3 inches.

Habitat and Range. These species are found attached to rocks between tide lines. *A. peruviana* ranges from San Pedro to Peru, and *P. macroschismus* is found from Alaska to Lower California.

Notes. The rock oysters are edible, but as they are not very abundant they are seldom taken in any quantity.

Other Name. Jingle shell.

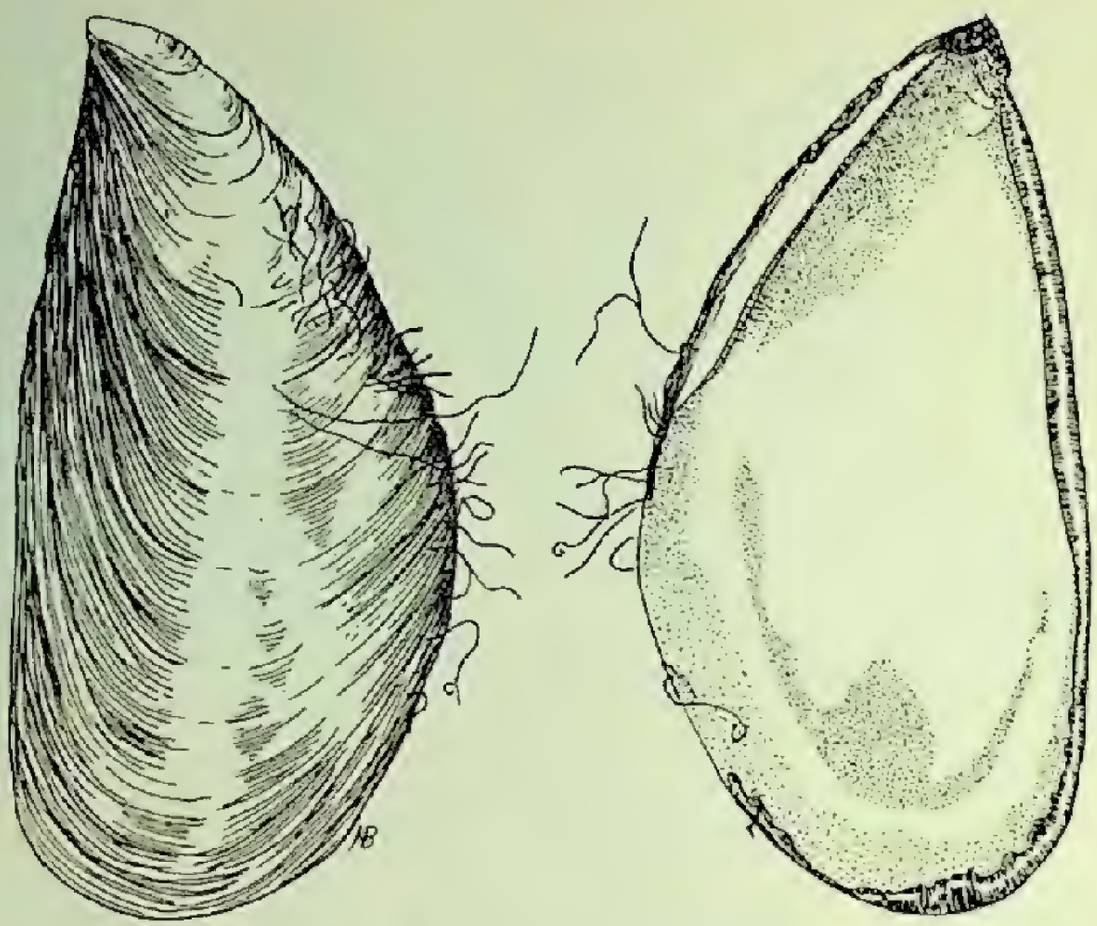


FIG. 84. Sea mussel, *Mytilus californianus;* actual size.

Sea Mussel

Mytilus californianus

Description. Valves elongated, purple in color, covered with a black, glossy periostracum; marked with faint concentric lines. Two muscles. Umbo at extreme end. Meat bright orange. Size up to 8 inches.

Habitat and Range. The sea mussels are found attached to rocks, sometimes in great mats, by the byssus. They live between tide lines where they are exposed to the full force of the surf. Being able to maintain themselves in this exposed situation, they receive the benefit of the oxygen-saturated "white water." Although this is the normal habitat, the adults are able to move about and burrow with the aid of the foot. The range is from Alaska to Mexico.

Notes. Mussels are used more or less extensively for food. During the summer months, it is well to ascertain whether there is any "red water" in the vicinity when gathering mussels for food, as it has been shown that by ingesting some of the organisms which constitute "red water," the mussels become toxic, sometimes to the extent of being lethal to human beings. Many deaths have occurred as a

result of eating mussels and other bivalves gathered along the open coast during periods of red water.

A large mussel may produce 100,000 eggs during a season. Under favorable conditions young mussels sometimes grow to 3½ inches the first year.

Other Name. Big mussel.

Bay Mussel

Mytilus edulis

Description. Appearance same as the sea mussel, except that the shell is proportionately wider and seldom exceeds 2 inches in length.

Habitat and Range. The bay mussel is found in beds attached to rock or shells in bays and inlets from the Arctic Ocean to Lower California.

Notes. This is the mussel which is highly prized as an article of diet in Europe, where it is cultivated for the market. It is used to some extent in our local markets but is not sold in the summer months during the occurrence of "red water."

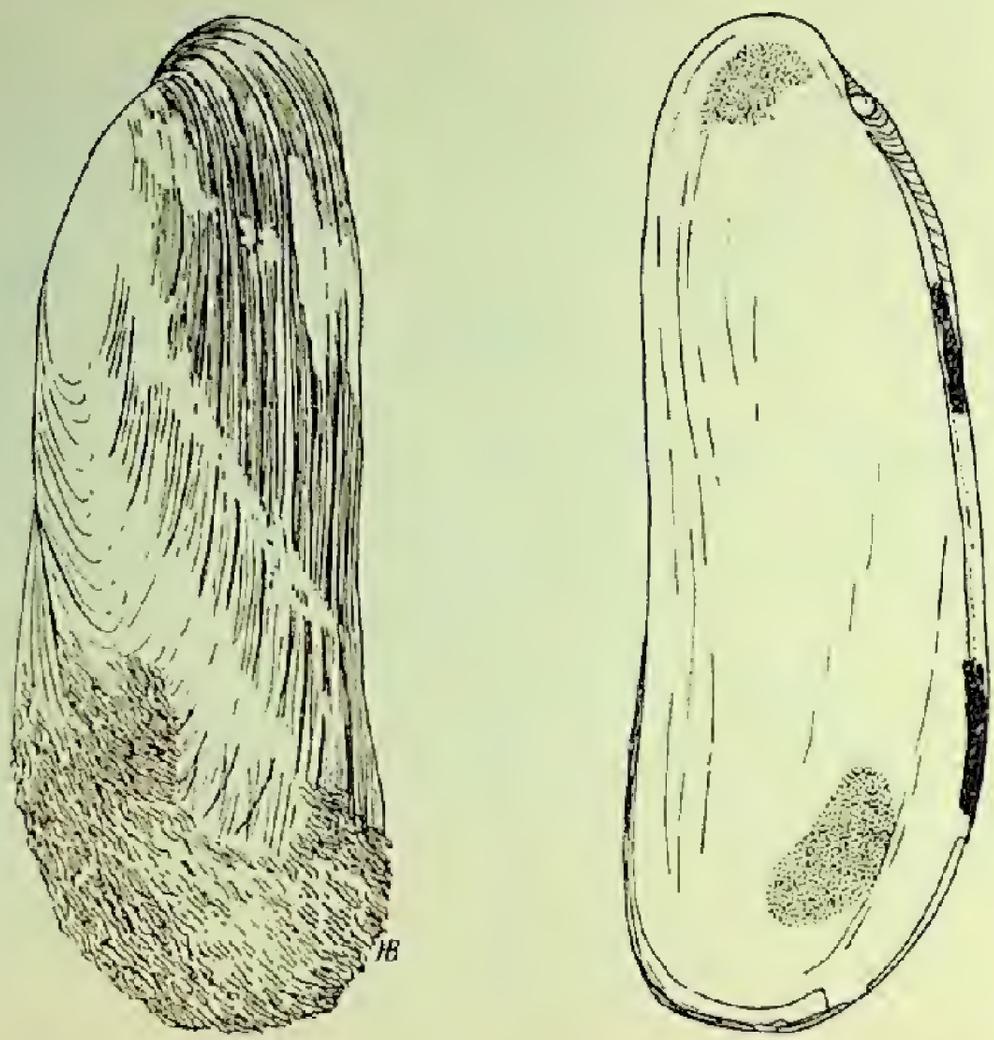


FIG. 85. Slender horse mussel, *Modiolus rectus*; three-fifths actual size.

Horse Mussels

Modiolus rectus and *Modiolus modiolus*

Description. Umbos near but not at the extreme end. Valves brownish and either bearded or markedly ribbed. The meat is orange or reddish. *M. modiolus* reaches a size of 9 inches.

Habitat and Range. The horse mussels are solitary species, generally found partly buried and anchored securely by the byssus in sandy mud or gravel. The giant horse mussel, *M. modiolus*, occurs from Alaska to San Pedro; the slender horse mussel, *M. rectus*, from Bolinas Bay to Lower California.

Notes. The horse mussels are good to eat and in some places can be gathered in considerable quantity. They are not abundant enough to have any commercial value.

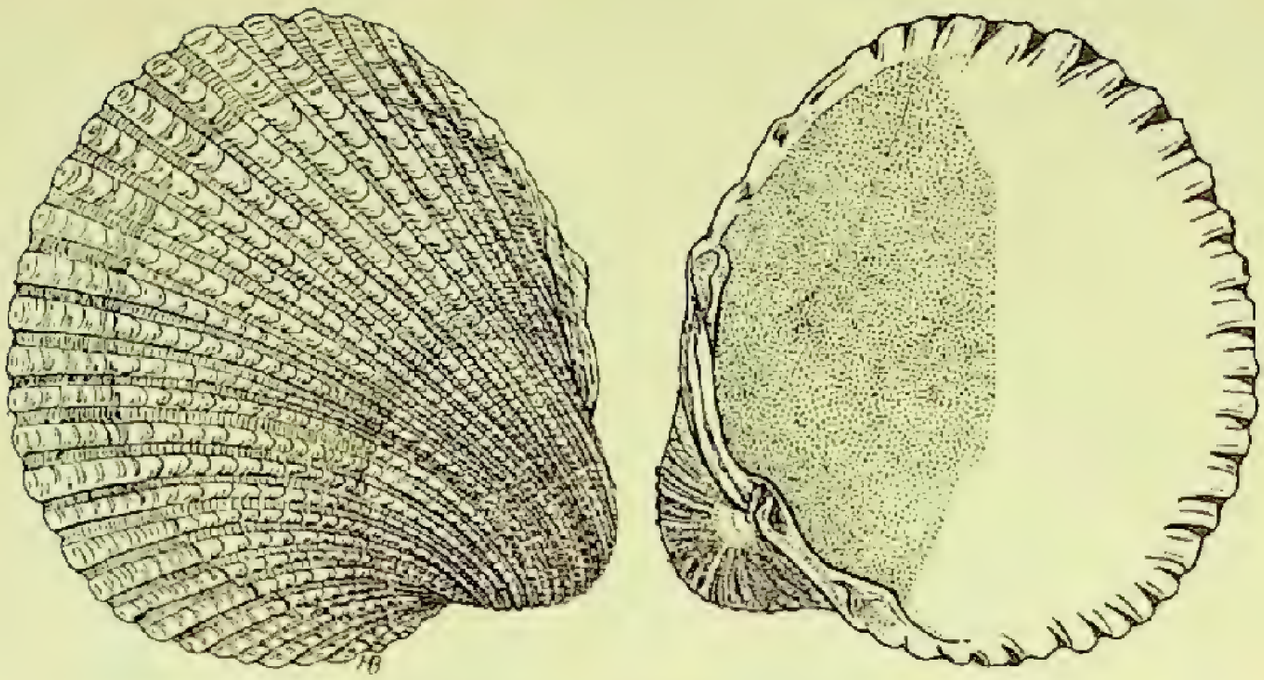


FIG. 86. Heart cockle, *Cardium corbis*; actual size.

Heart Cockle

Cardium corbis

Description. Valves strongly arched, symmetrical, with prominent radiating ribs and grooves which interlock at the edges as in the scallop. The siphons are very short. The mantle margins are fused at two points to form siphon openings. This species attains a size of 2¾ inches.

Habitat and Range. The heart cockle is found on the tide flats in inlets and bays and also on sand and gravel beaches. These cockles live on the surface or just beneath it. They are active diggers but their short siphons do not allow them to burrow to any great depths. In the Puget Sound region, they are sometimes found in extensive beds. The range is from Puget Sound to Mexico.

Notes. The cockles are very good to eat but can not be found in sufficient quantities locally to be of commercial importance. The San Francisco markets and restaurants handle considerable quantities which are shipped in from Puget Sound.

Other Names. Heart shell, quahaug, basket cockle.

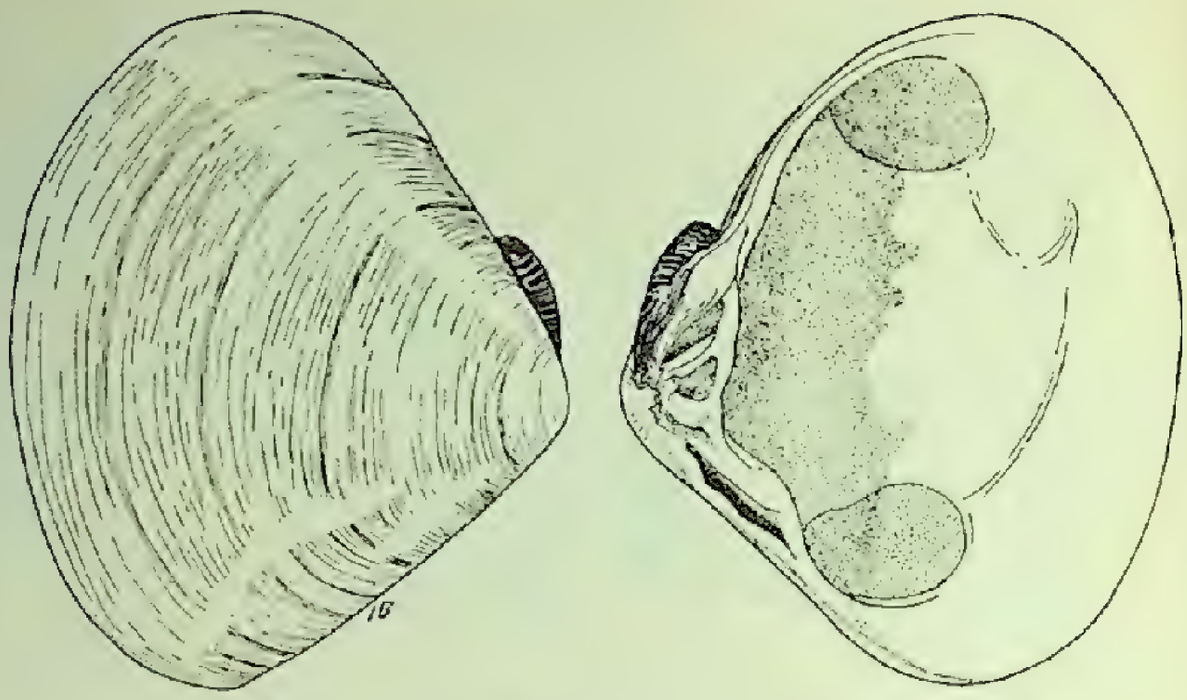


FIG. 87. Pismo clam, *Tivela stultorum;* one-half actual size.

Pismo Clam

Tivela stultorum

Description. Valves large, thick and massive. Covered with a thick, glossy periostracum. Color, pale fawn with faint concentric purplish rings; some individuals are dark brown and some are bicolored; occasional specimens with radiating stripes of brown. Muscle scars purple. Thin, strong foot and short siphons which are separate at the tips. Specimens of 7 inches are found but are not very common; due to depletion resulting from intensive digging, large clams are now scarce. The minimum size limit is 5 inches.

Habitat and Range. The Pismo clam is found on open, flat, sandy beaches between Half Moon Bay and Lower California.

Notes. Living as they do in the sand under the breaker line, it is necessary for the Pismo clams to be strong active diggers, as the sand on the beaches is shifted continually by wave action. During exceptionally heavy storms, they are sometimes so mauled and pounded by the waves that they are thrown up on the beaches in great numbers. So desirable are these clams for food that stringent laws have been necessary to save them from extinction. Under the present legal restrictions, they can be used commercially to a limited extent only, but probably many more are taken by casual diggers than are used commercially. A number of years ago these clams were so plentiful that they were turned out of the sand at low tide with teams and plows and used for hog feed.

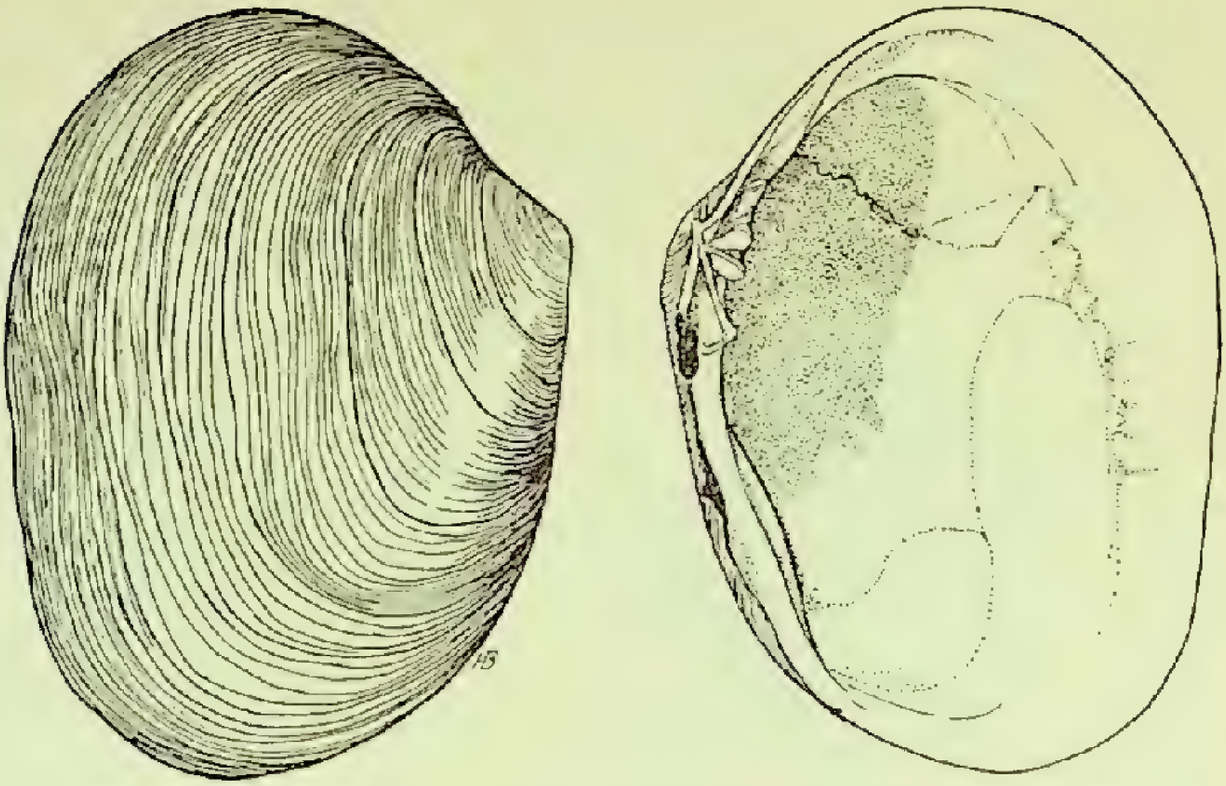


FIG. 88. Washington clam, *Saxidomus nuttalli;* two-thirds actual size.

Washington Clam

Saxidomus nuttalli

Description. Shell oval, outside surface with numerous strongly defined concentric growth lines. Color, outside brownish white; inside white, slightly tinged with purple near the siphonal end. Siphons united, long and retractile. Grows to a length of 9 inches.

Habitat and Range. The Washington clam lives at a depth of 8 to 10 inches in the mud flats of all bays and inlets from Alaska to San Diego. Where they are not found in a bay, it generally means that persistent digging has caused a scarcity.

Notes. Because of their size and firm white meat, these are among the finest of the bay clams. In hard bottoms or in gravel they must be dug out with a shovel, but in soft mud they are obtained with a clam hook. The taxonomists have made two species of *Saxidomus* on the coast, *nuttalli* from Humboldt Bay to San Diego and *giganteus* from Humboldt Bay to Alaska. An examination of these two supposed species shows such minute differences, if any, that lacking the geographical origin no one would be able to place a specimen definitely as to species.

Other Names. Money shell, butter clam, Martha Washington clam, big clam.

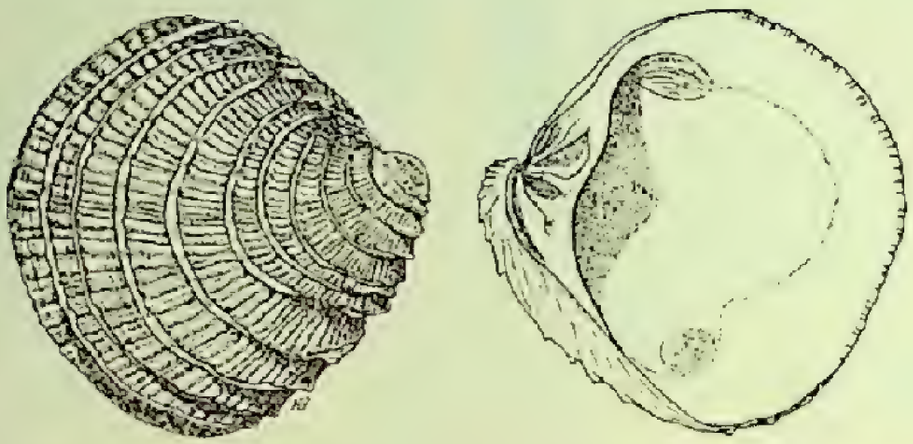


FIG. 89. One of the hard-shell cockles, *Chione succincta;* actual size.

Hard-shell Cockles

Chione fluctifraga, Chione undatella, Chione succincta

Description. Compact rounded valves with radiating and concentric ridges. Short united siphons. Shells covered by a thin gray periostracum. They reach a size of 2 to 2½ inches.

Habitat and Range. These clams live just under the surface in firm sand or sandy mud in bays and inlets. The siphonal ends of the valves are sometimes visible. The range is from San Pedro southward into Mexico.

Notes. Sufficiently abundant to be used commercially, these clams can be obtained in the markets in the southern part of the State. They are in great demand by restaurants for chowders.



FIG. 90. Rock cockle, *Paphia staminea*; actual size.

Rock Cockle

Paphia staminea

Description. Valves are rounded and strongly arched with boldly radiating ribs. Color yellowish white, often with brown marks. Siphons united. Size up to 3 inches.

Habitat and Range. This species is found on sandy beaches and on gravel bars and reefs near the entrances of bays and inlets. It does not occur in deep soft mud. It is taken occasionally at the surface, but in a firm bottom will burrow to a depth of from 3 to 8 inches. The range is from Alaska to Mexico.

Notes. In favorable localities these clams form beds, sometimes of considerable extent. They are one of the principal commercial clams, but as the local beds are of small size most of the market clams are imported from the more extensive beds of the Puget Sound region.

Other Names. Little neck clam, hard-shell, rock clam, cherry stone, sweet clam, ribbed carpet shell.

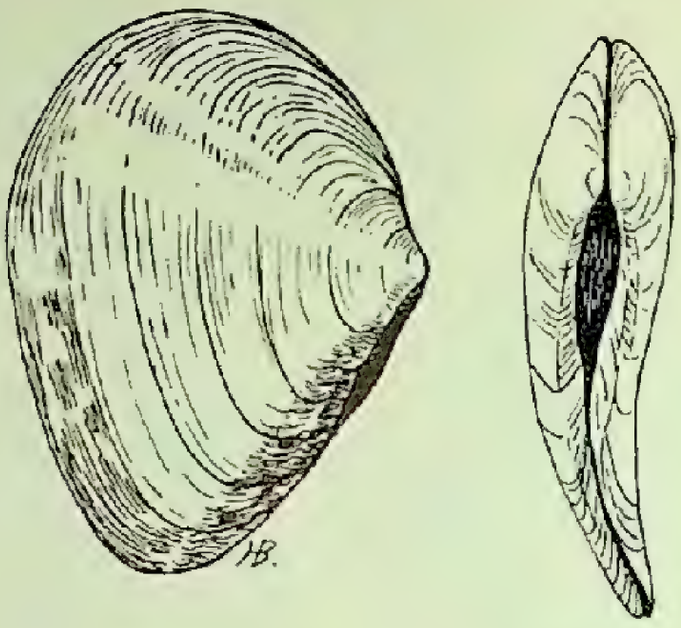


FIG. 91. Bent-nosed clam, *Macoma nasuta*; actual size.

Bent-nosed Clam

Macoma nasuta

Description. Valves oval, whitish, light and thin, siphonal end bent strongly to the right. Siphons separate and very long. Size up to 2½ inches.

Habitat and Range. The bent-nosed clam lies on the left side at a depth of 6 to 8 inches in all muddy bays from Alaska to Lower California.

Notes. Bent-nosed clams can usually be obtained when other species are not available. They are very hardy and resist adverse conditions that would be fatal to other forms. At one time a considerable quantity was marketed in San Francisco. They require special treatment as the gut is usually full of mud or sand. The market diggers hold them for several days in floats or boxes full of sea water which is changed frequently, thus allowing them to clean themselves. Clam broth can be obtained by steaming and straining the resulting liquid.

Other Name. Mud clam.

White Sand Clam

Macoma secta

Description. The two valves are different, the left being flatter, otherwise similar to *Macoma nasuta*.

Habitat and Range. Found in sand, generally about 1½ inches below the surface, from Vancouver Island to the Gulf of California in both bays and ocean beaches.

Tellen

Tellina bodegensis

Description. Valves elongated, flattened, symmetrical, pure white with a smooth polished surface. Siphonal end bent to the right. Siphons separate, slender and very long. Reaches a size of 2½ inches.

Habitat and Range. Found on sand beaches from British Columbia to Lower California.

Notes. A very active digger. Does not occur in great abundance.

Sunset Shells

Psammobia californica and *Psammobia edentula*

Description. Valves thin, oval, the right flatter than the left, with the siphonal ends bent slightly to the left. Heavy, varnish-like periostracum. Purplish tinge inside and out. Siphons separate and long. Size up to 3½ inches.

Habitat and Range. Found at a depth of one inch in coarse sand and gravel, where it lies on the right side with the flat valve down, convex up. The siphon holes are generally about three inches apart at the surface. *P. californica* is found all along the California coast and *P. edentula* ranges from San Pedro to Lower California. Sunset shells are found both in bays and along the open coast.

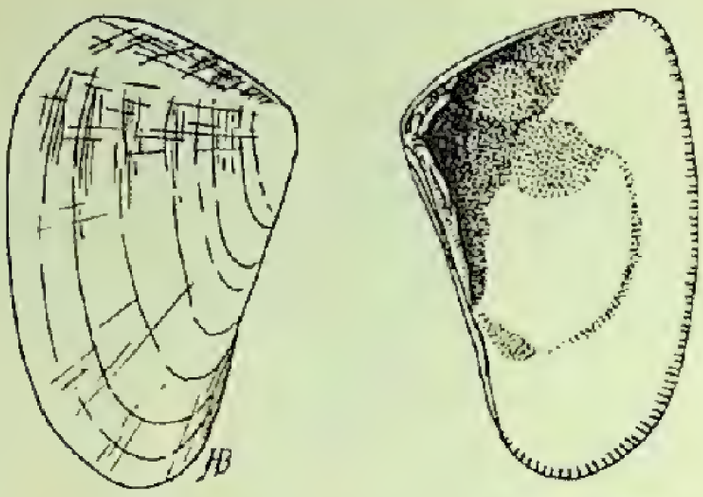


Fig. 92. Bean clam, *Donax gouldii;* twice actual size.

Bean Clam

Donax gouldii

Description. Valves heavy and strong, strongly arched, marked with indistinct radiating lines and concentric growth lines. Posterior or siphonal end abruptly cut off. Valve margins heavily crenulated, interlocking. Color from white to blue and purple, sometimes striped. The siphons are separate. Size to one inch.

Habitat and Range. On the surface or just under the surface of open sandy beaches from Santa Barbara to Panama.

Notes. The winter storms sometimes wash these clams up on the beaches in extensive windrows. At such times they can be gathered in great quantities and steamed for broth.

Other Name: Wedge shell.

Yellow Jackknife Clam

Solen sicarius

Description. Not as large as *Tagelus.* Umbos at anterior end. Valves slightly bent. Periostracum glossy, yellow. Siphons united and of medium length. Size up to $3\frac{3}{4}$ inches.

Habitat and Range. Burrows like *Tagelus,* and is found from Vancouver Island to Lower California.

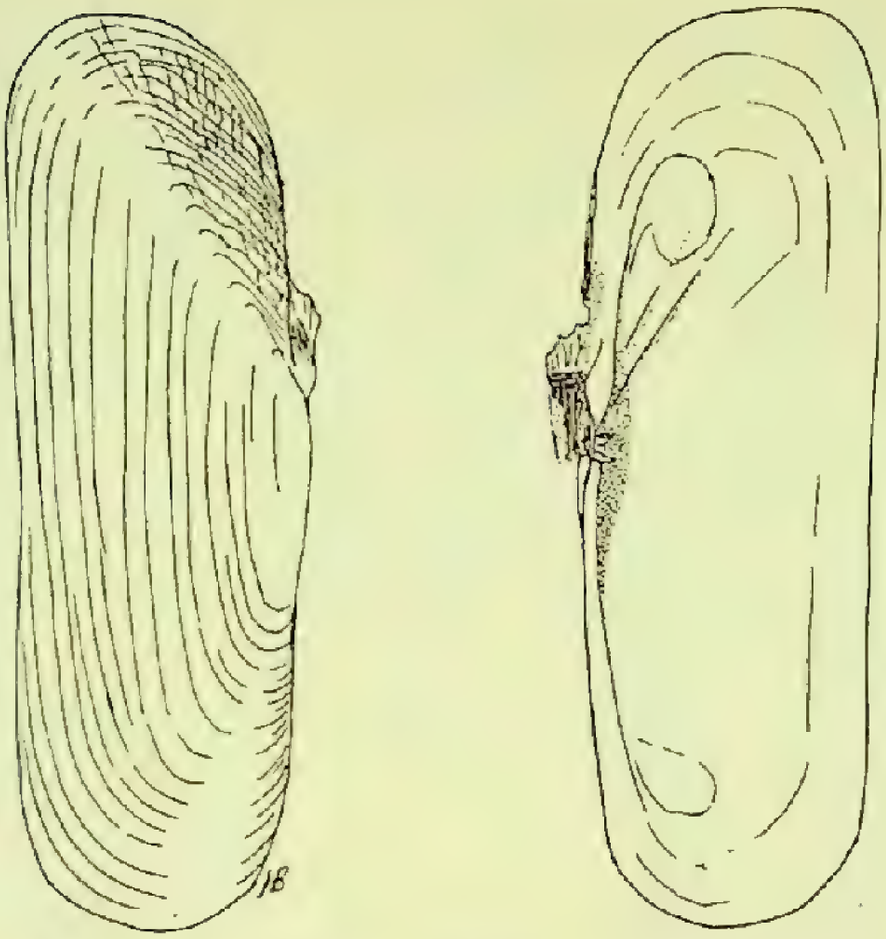


FIG. 93. Jackknife clam, *Tagelus californianus;* actual size.

Jackknife Clam

Tagelus californianus

Description. Valves 3 to 4 times as long as wide. Strongly arched, almost forming a cylinder. Umbos central, siphons separate and long. Color, white or grayish; dull brownish periostracum. Size up to 4 inches.

Habitat and Range. This species lives in a smooth-lined permanent burrow, 15 to 16 inches deep, in quiet bays with a fairly stable bottom, from Santa Barbara to Mexico.

Notes. The siphons of these clams come to the surface an inch and a half or two inches apart. When disturbed they retreat to the bottom of their burrow and if still pursued will hurriedly dig away into the surrounding mud. This clam is extensively used as bait by fishermen in southern California. It is seldom eaten.

Other Name: Razor clam.

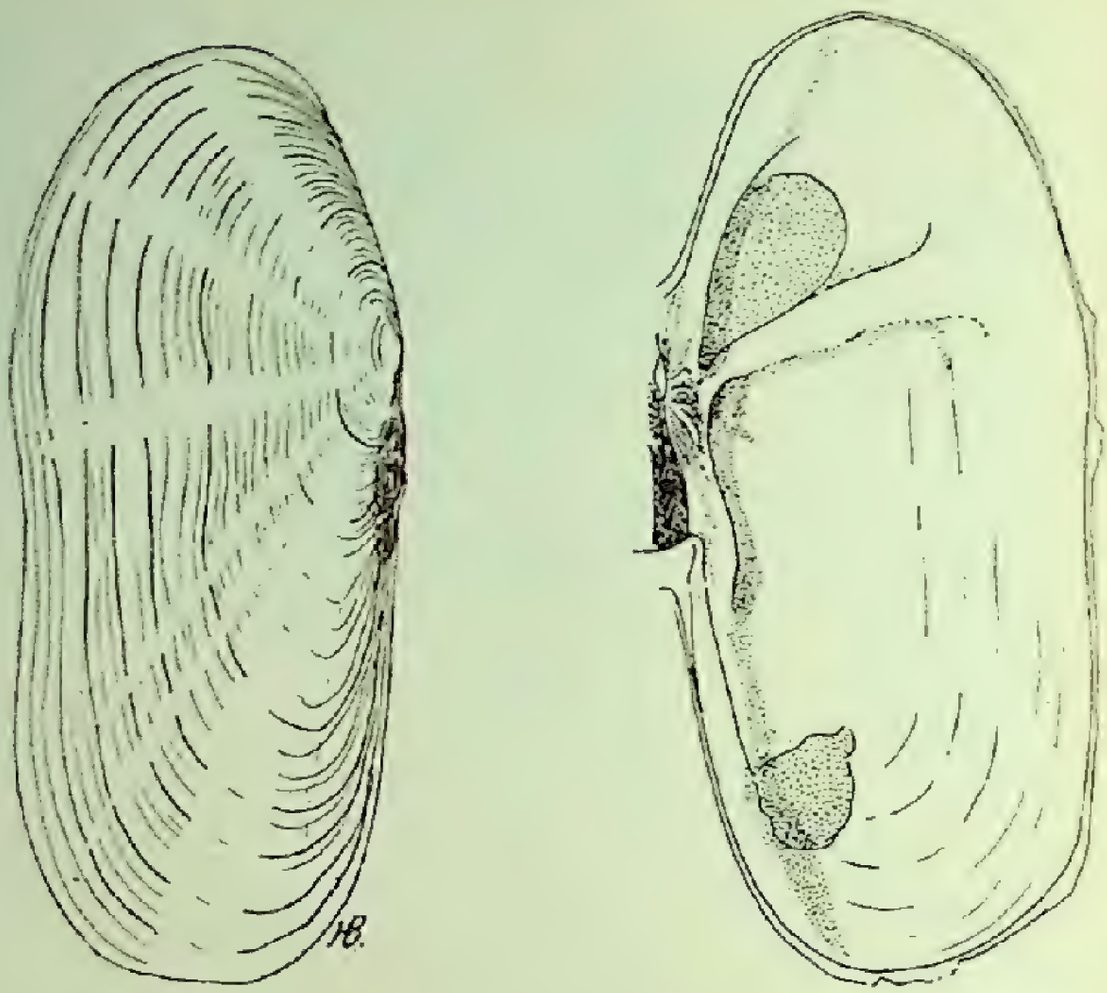


FIG. 94. Northern razor clam, *Siliqua patula;* three-fourths actual size.

Razor Clams

Siliqua patula and *Siliqua lucida*

Description. Slender form, valves little arched and very thin and delicate. Periostracum glossy and varnish-like. Foot large and powerful. Siphons short and united except at the tip. *S. lucida* tinged with violet, *S. patula* horn colored. Conspicuous ridge on inside of shell extending outward from the umbo. Size up to 6 inches.

Habitat and Range. Broad, level, sand beaches under the surf line are the homes of these clams. The northern razor clam, *S. patula*, is found from Alaska to San Luis Obispo County; the southern razor clam, *S. lucida*, from Monterey to Lower California.

Notes. The razor clam is a highly specialized form whose continued existence depends on its ability to move rapidly under the sand beaches where it makes its home. The low, flat beaches, where the razor clam is found, have a surface layer of 6 or 8 inches which is hard-packed sand able to support the automobiles of the clam diggers. Beneath this surface layer extending downward to an unknown depth, the sand is so impregnated with water that in places it may resemble

a thick gruel. It is through this substratum that the clams move about so rapidly that failure to turn them out at the first stroke of the shovel generally means that they are lost. The clams lie close to the surface with the tip of the siphons exposed and the hinge toward the sea. Experienced diggers walk slowly along the beach, tapping the sand with the shovel handle. The vibration causes the clam to start downward and the sudden withdrawal of the body and siphon leaves a characteristic hole and pit. The digger rapidly spades out one shovelful of sand and then having reached the semi-fluid region of sand and water, pursues the clam by thrusting the hand and arm down into the hole. All this must be done very rapidly, a matter of a few seconds, or the clam will be beyond reach. The depth to which the clams dig is not known. They very probably do not move straight down but veer off in a horizontal direction. When, as an experiment, a bent pin with a string attached was suddenly hooked into the exposed end of the siphon, one clam took ten feet of string into the sand in a few minutes.

Razor clams have an excellent flavor which has led to their depletion in this State from over-utilization by both commercial and amateur diggers.

Other Names. Razor shell, sea clam.

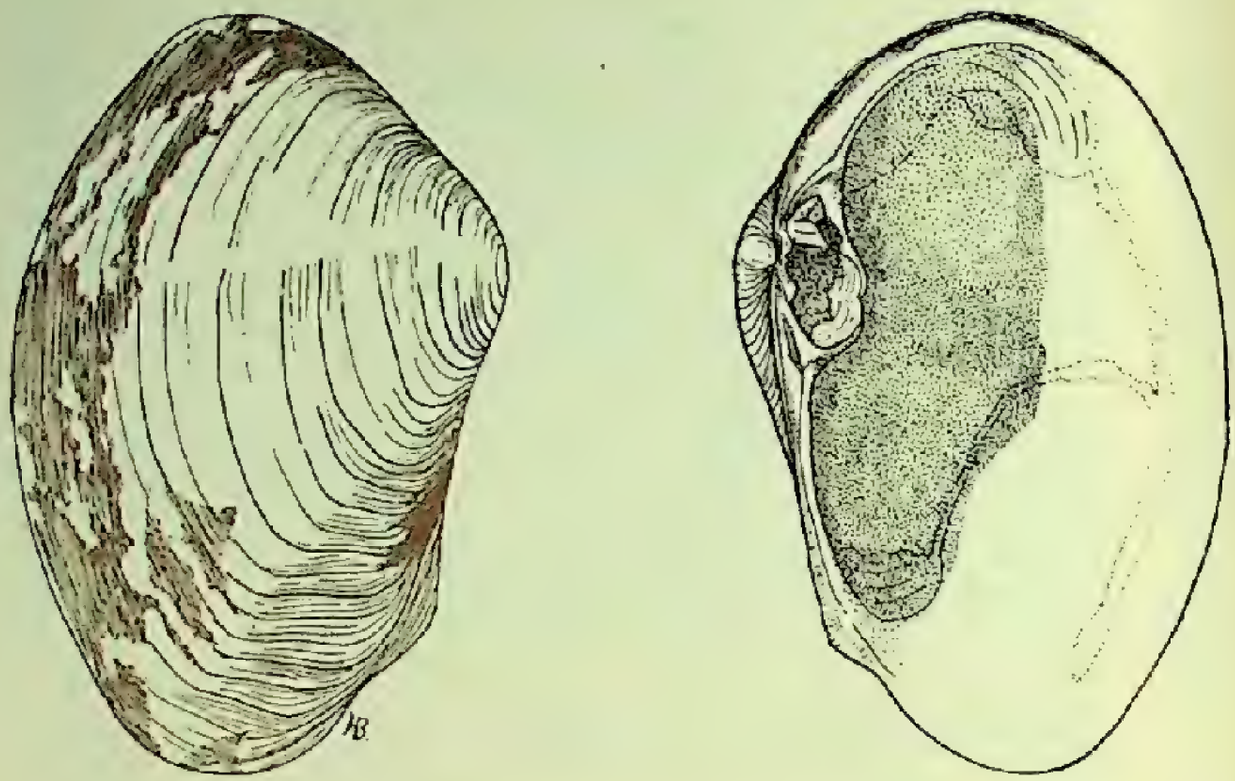


Fig. 95. Gaper, *Schizothaerus nuttallii*; one-half actual size.

Gaper

Schizothaerus nuttallii

Description. Valves thin, can not close completely, curved outward at the end to accommodate the siphons. Siphons large, covered with heavy, dark skin and tipped with two horny plates. Umbos toward anterior end of shell. Grows to 8 inches in length and 4 pounds in weight.

Habitat and Range. The gaper lives in the mud bottoms of all bays and inlets from Alaska to San Diego. According to the nature of the bottom they may be found at a depth of from 1 to 3 feet.

Notes. With the exception of the geoduck, the gaper is the largest clam to be found on our coast. The body is quite small in comparison to the great "neck" with its tough brownish skin. From a gastronomical standpoint it is near the top of the list of edible bivalves. The meat is white and has a very fine flavor. The muscular siphons are best utilized by pounding or by being ground up and made into a chowder. In some localities the gapers have been so assiduously taken for chowders that they are comparatively scarce. Near the western end of Tomales Bay, the gapers are featured as Tomales Bay giant clams, and digging them is one of the high spots for vacationists from inland.

Other Names. Horse clam, great Washington clam, summer clam, otter shell, geoduck, big-neck clam.



FIG. 56. Soft-shell clam, *Mya arenaria*; actual size.

Soft-Shell Clam

Mya arenaria

Description. Valves light and brittle, oval, siphonal end more pointed. Color whitish, thin gray periostracum, cartilage internal, left cartilage pit on a projecting tooth (no other clam has this except *Platyodon*). They reach a size of 5 inches.

Habitat and Range. Found in soft mud in sheltered bays from British Columbia to Monterey.

Notes. The soft-shell clam is not a native species but was accidentally introduced from the Atlantic Coast about 1870 with the first shipments of eastern oysters to San Francisco and Willapa bays. It was later planted in several other bays and has spread up and down the coast from these points. It has found the West Coast so favorable as a place to live that it has become one of the most important of the commercial clams. Although it is present in all suitable localities, there are few places in California bays where it attains commercial abundance unless protected from the sting ray. This is accomplished by surrounding a suitable mud flat with a stake fence. Several of these staked beds near San Francisco have been producing soft-shells in commercial quantities for forty or fifty years.

Other Names. Soft-shell, long clam, mud clam, eastern clam, soft clam.

Geoduck

Panope generosa

Description. Valves light, marked with broad, rounded growth lines. Siphonal end flares to accommodate the siphons, which are united, very long and massive. The shell grows to be 8 inches long. The clam attains a weight of 6½ pounds.

Habitat and Range. The geoduck lives deep in the unshifting mud bottoms of sheltered bays from Alaska to Mexico.

Notes. Although the geoduck is a very superior food mollusk and its great size makes it unnecessary to obtain many of them, they are not of great importance either to the casual clam digger or to the commercial man. They are relatively scarce, and as they must be dug from a depth of from 3 to 4 feet not many are taken. Because of the situation in which it lives, the geoduck is comparatively safe from its enemies and has no need for much activity. The extension and retraction of the great siphons are the extent of its exertions. The slight movement of the body resulting from these activities enlarges the cavity in which it lives and accommodates growth.



FIG. 97. Rough piddock, *Zirfaea pilsbryi*; actual size.

Rough Piddock

Zirfaea pilsbryi

Description. Anterior end of valves with serrations and teeth. Shell gapes widely, hinge is protected by a pad-like membrane. Valves thin, large conspicuous spoon-shaped process projected from the umbo inward. Grows to be 4½ inches in length.

Habitat and Range. Usually found in stiff clay or soft rock either in bays or on the open coast, from Alaska to San Diego.

Notes. The following remarks refer to the rough piddock and the two species of rock borers referred to below. The boring clams actively hollow out the cavity in which they live by turning the shell from side to side. In soft rock where they have begun their burrows when small, the burrow will be progressively large from the surface downward, leaving an opening at the surface just large enough for the extrusion of the siphon tips. In such a situation the clam is safe from all its enemies and even human diggers must use a pick to break the surrounding rock in order to obtain them. The boring clams are very good food although not relished by some because of their "strong" flavor.

Other Names. Piddock, borer, boring clam.

Rock Borer

Parapholas californica

Description. Anterior end of valves roughened and round, siphonal end terminates in soft scales. Shell can be completely closed. Hinge protected by two long slender plates. Siphons completely retractile. Reaches a length of 3 inches.

Habitat and Range. Found in much the same situation as *Zirfaea*, from Coos Bay to San Diego.

Other Names. Piddock, boring clam, borer.

Rock Borer

Pholadidea penita

Description. Appearance much the same as the preceding species. Siphonal end of valves covered with brownish scales. Hinge plates short and triangular. Grows to a length of 3 inches.

Habitat and Range. Lives under the same conditions as the other boring clams, from Alaska to Mexico.

Other Names. Rock clam, piddock, China clam, boring clam.

GENERAL DISTRIBUTION OF BIVALVES IN CALIFORNIA

The principal areas where bivalves may be found on the California coast in some quantity are shown in the accompanying table. There are many sand and gravel beaches of small extent along the coast where clams can be found. Such species as the sea mussels are found everywhere on the open coast where there are rocks to give them anchorage.

Washington clams and gapers, although usually considered bay clams, can be sometimes dug in sand or gravel beaches.

ENEMIES OF BIVALVES

The bivalves in common with all other organisms have natural enemies. Starfish account for a good many, mostly those on or near the surface. The moon snail (*Polinices*), an active predacious drill, follows the siphons of the clams down into the mud and sand and eats the owners. Storms, shifting bottoms and freshets kill clams, sometimes in great numbers. Flounders nip off the exposed tips of the siphons when opportunity offers. The regenerative powers of the mollusks is such that a siphon tip can be replaced, but if too much is gone or if a second piece is removed after the replacement of the first, the clam dies. The greatest enemy of the bay clams is

the sting ray (*Aetobatus*). This flat, bottom-living fish actively digs clams, sinking the body into the soft mud bottom by pulsing movements of the "wings." They sometimes drive a shallow ditch across a prolific clam area. The clam is pulled out and crushed by the powerful pavement teeth. Sting rays are found from Humboldt Bay south into Mexico. They live in the open ocean during the winter, appearing in the bays and inlets during April and remaining until the end of August.

Principal Areas Where Bivalves Can Be Found in Quantity

	Crescent City	Little River	Humboldt Bay	Bodega Bay	Tomales Bay	Bolinas Bay	San Francisco Bay	Halfmoon Bay	Monterey Bay	Elkhorn Slough	Morro Bay	Pismo Beach	Ventura beaches	Anaheim Slough	Newport Bay	Mission Bay	San Diego Bay
Scallop											x			x	x	x	
Bay mussel			x				x			x					x		x
Horse mussels			x				x										x
Heart cockle	x	x	x	x	x		x			x	x	x		x	x	x	x
Rock cockle			x	x				x	x				x				
Hard-shell cockles														x	x	x	x
Pismo clam									x			x					
Washington clam			x	x	x	x	x	x		x	x					x	x
Bent-nosed clam			x	x	x	x	x			x	x			x	x	x	x
Jackknife clams							x							x	x	x	x
Razor clams	x	x									x	x					
Gaper			x	x	x	x	x			x	x			x	x	x	x
Soft-shell clam			x	x	x	x	x			x							
Geoduck			x								x						
Boring clams			x		x			x						x	x		

CALIFORNIA LAWS RELATING TO CLAMS

1939-1941

Licenses

Sport fishing license required to take Pismo clams, cockles, scallops and jackknife clams.

Commercial fishing license to take any clam for sale.

Seasons

In Districts 8, 9 and 17, clams may be taken between September 1 and April 30, only. In all other Districts at any time.

Bag Limits, Sizes, etc.

Pismo clam	15 per day	5-inch minimum size. Can not be transported.
Northern razor clam	30 per day	
Jackknife clam	30 per day,	(Except in District 19 and Mission Bay where there is no limit.)
Gaper	10 per day	
Washington clam	10 per day	(In Districts 2 and 10.)
Cockles (*Chione fluctifraga, C. undatella, C. succincta, Paphia staminea, P. tenerrima*)	6 doz. per day	1½-inch minimum size.
Scallops		2-inch minimum size. Can not be sold.

In addition, there are other laws relating to closed areas, shipping, and night digging.

Mussels may not be sold or offered for sale during the summer months when the "red water" appears offshore, by a regulation of the California State Board of Health. The time of quarantine varies from year to year.

REFERENCES

Beard, H. R., comp.

1926. Nutritive value of fish and shellfish. U. S. Commissioner of Fisheries. Report, 1925, app. X, doc. 1000, pp. 501-552.

Bonnot, Paul.

1932. Soft shell clam beds in the vicinity of San Francisco Bay. California Fish and Game, vol. 18, pp. 64-66.

Edmondson, C. H.

1920. Edible Mollusca of the Oregon coast. Bishop Museum, Honolulu. Occasional Papers, vol. 7, no. 9, pp. 179-201, 6 figs.

1923. Shellfish resources of the northwest coast of the United States. U. S. Commissioner of Fisheries. Report, for 1922, app. III, doc. 920, 21 pp., 25 figs.

Johnson, M. E.
1937. West coast marine shells. Ann Arbor, Edwards Bros., Inc.

Johnson, M. E., and Snook, H. J.
1927. Seashore animals of the Pacific coast. New York, Macmillan Co., pp. 411-470.

Keen, A. M., and Frizzell, D. L.
1939. Illustrated key to west North American pelecypod genera. Stanford University Press. 28 pp., illus. (mimeographed).

Keep, J.
1935. West coast shells. Stanford University Press. 350 pp., illus.

MacGinitie, G. E.
1935. Ecological aspects of a California marine estuary. American Midland Naturalist, vol. 16, no. 5, pp. 629-765, 21 figs.

Ricketts, E. F., and Calvin, Jack.
1939. Between Pacific tides. Stanford University Press. 320 pp., 112 figs.

Thompson, W. F.
1914. Report on the shellfish beds of British Columbia. British Columbia Commissioner of Fisheries. Report for 1913, pp. R103-R125.

Weymouth, F. W.
1920. The edible clams, mussels and scallops of California. California Fish and Game Commission. Fish Bulletin, no. 4, 72 pp., 19 pls., 26 figs.

THE MAMMALS OF NAPA COUNTY, CALIFORNIA [1]

By William M. Longhurst

INTRODUCTION

Napa County, California, occupies an area of approximately 783 square miles lying on the northeast side of San Pablo Bay. Most of the County is mountain or hill land except the floors of the Napa and Berryessa valleys and the salt marshes in the southwestern part. Mount Saint Helena at the northwestern corner, with an elevation of 4343 feet, is the highest point, and the salt marshes lying at sea level in the southwestern corner are the lowest. Two main streams drain the County—the Napa River on the west which has its headwaters near Calistoga and flows south into the Carquinez Straits at Vallejo, and Putah Creek on the east which flows in a southeasterly direction to the Sacramento Valley. The drainage from Napa, Foss and Conn valleys flows into the Napa River, and the drainage from Berryessa, Capell, Pope and Chiles valleys flows into Putah Creek. Wooden and Gordon valleys have separate drainages into Suisun Bay.

Napa County may be divided into a number of biotic areas based primarily on the floral associations. Most of the mountain and hill land is typical Upper Sonoran life-zone, but at the northern end of Napa Valley there is a considerable area of Humid Transition life-zone characterized by redwoods, Douglas firs and yellow pines. On the west side of the Valley this association extends south in the Mayacamas Range to a point almost opposite the town of Napa, and on the east side of the Valley yellow pines extend as far south as Howell Mountain in the Napa Range. In a canyon on the north side of Mount George, which is directly east of Napa, there is a small grove of redwoods, but this is merely an isolated Transition island and is surrounded on all sides by Upper Sonoran flora.

In the Upper Sonoran life-zone the oaks form the dominant forest, but there are many areas of true chaparral. Live oaks are more abundant in the western part of the County, but are gradually replaced by blue oaks toward the east, until in the Vaca Range along the County's eastern boundary live oaks are only found in the deeper canyons and along streams. Most of the extensive areas of chaparral are also found east of the Napa Valley. This gradation from west to east toward a more xerophytic type of flora appears to be correlated with the rainfall which averages about 25 inches per year at Napa, but only about 15 inches at Monticello in the Berryessa Valley. Average annual temperatures for the County range from an average maximum of 69° F. to an average minimum of 49° F.

Chaparral seems not to be a climax flora, but comes in only after fires and is gradually replaced by the climax oak association.

[1] Contribution from the Museum of Vertebrate Zoology, University of California, Berkeley, California. Submitted for publication, June, 1940. Photographs by the author.

Open grassland is found principally on the floors of the valleys and on the hills in the southeastern part of the County from Jameson Canyon south.

Salt marshes formerly extended up the Napa River almost to the town of Napa, very nearly coincident with the tide water, which on high tides reaches a point some two miles above the town. Now, however, all of the land above Cuttings Wharf, five miles south of Napa, has been reclaimed so that the salt marshes at the present time extend south from there to the boundaries of the County. Even within this area much land has been reclaimed so that true salt marsh conditions are found chiefly along the banks of tidal sloughs.

The following list indicates most of the dominant plants in each floral association.

Transition Life-zone

Humid Phase

Sequoia sempervirens
Pseudotsuga taxifolia
Lithocarpus densiflorus
Umbellularia californica
Arbutus menziesii
Ceanothus thrysiflorus

Upper Sonoran Life-zone

Oak Association—Upland Phase

Quercus agrifolia
Quercus douglasii
Quercus kelloggii
Quercus lobata
Umbellularia californica
Arbutus menziesii
Photinia arbutifolia
Rhus diversiloba
Aesculus californica
Arctostaphylos viscida
Arctostaphylos stanfordiana
Arctostaphylos glandulosa
Arctostaphylos manzanita

Oak Association—Riparian Phase

Alnus rhombifolia
Acer macrophyllum
Salix lasiandra
Salix lacvigata
Salix lasiolepis

Chaparral Association

Adenostoma fasciculatum
Quercus durata
Quercus dumosa
Arctostaphylos glandulosa
Arctostaphylos viscida
Ceanothus foliosus
Ceanothus parryi
Ceanothus sorediatus
Ceanothus incanus
Ceanothus cuneatus
Ceanothus jepsoni

Grassland Association

Medicago hispida
Avena fatua
Bromus rubens
Bromus rigidus
Bromus secalinus
Bromus carinatus
Festuca pacifica
Agropyron tenerum
Elymus glaucus
Hordeum murinum

Salt Marsh Association

Salicornia ambigua
Distichlis spicata
Grindelia cuneifolia
Baccharis douglasii
Spartina foliosa
Scirpus acutus
Juncus lescurii
Typha latifolia

The distributions of the following mammals have been found to be limited to certain floral associations:

Salt Marsh

Reithrodontomys raviventris halicoetes *Microtus californicus aestuarinus*
Sorex sinuosus

Oak, Chaparral, and Humid Transition

Lynx rufus californicus
Urocyon cinereoargenteus townsendi
Neotoma fuscipes fuscipes
Sciurus griseus griseus
Spilogale gracilis phenax
Eutamias sonomae
Sorex trowbridgii montereyensis
Odocoileus hemionus columbianus

A number of races of mammals found in Napa County show intergradation between races characteristic of the Humid Transition life-zone on the Pacific Coast and the Lower Sonoran life-zone in the Sacramento and San Joaquin valleys. Likewise some affinities are shown toward races found in the Arid Transition life-zone of the inner north coast ranges. Elements of each of these life-zones are found in the flora of Napa County, bringing with them some representatives of their characteristic faunas.

These following races of mammals found in Napa County show evidence of intergradation:

Sorex trowbridgii montereyensis toward *S. t. mariposae* of the Arid Transition life-zone.

Myotis californicus caurinus toward *M. c. californicus* of the Lower Sonoran life-zone.

Thomomys bottae agricolaris toward *T. b. minor* of the Humid Transition life-zone.

Sylvilagus bachmani tehamae toward *S. b. ubericolor* of the Humid Transition life-zone and *S. b. riparius* of the Lower Sonoran life-zone.

The following list includes those mammals which have been found to occur within Napa County within recent years, and a few species, not supported by actual records, but known with fair certainty to occur there. The grizzly bear and the Roosevelt elk which have been extinct for many years are not included, although they once may have occurred in the County.

Scapanus latimanus caurinus
Sorex trowbridgii montereyensis
*Sorex ornatus californicus**
*Sorex sinuosus**
Myotis evotis chrysonotus
Myotis thysanodes thysanodes
Myotis volans longicrus
Myotis californicus caurinus
Pipistrellus hesperus merriami
Eptesicus fuscus bernardinus
Lasiurus borealis teliotis
Lasiurus cinereus
Corynorhinus rafinesquii intermedius
Antrozous pallidus pacificus
Tadarida mexicana
*Ursus americanus altifrontalis**
Procyon lotor psora
Bassariscus astutus raptor
Mustela vison aestuarina
Lutra canadensis brevipilosus
Spilogale gracilis phenax
Mephitis mephitis occidentalis
Taxidea taxus neglecta
Urocyon cinereoargenteus townsendi
Canis latrans ochropus
Felis concolor californica
Lynx rufus californicus
*Zalophus californianus**
Citellus beecheyi douglasii
Eutamias sonomae

* Occurrence in Napa County not fully confirmed.

Sciurus griseus griseus
Thomomys bottae agricolaris
*Perognathus inornatus inornatus**
Dipodomys heermanni californicus
Reithrodontomys megalotis longicaudus
Reithrodontomys raviventris halicoetes
Peromyscus maniculatus gambelii
*Peromyscus boylii boylii**
Peromyscus truei gilberti
Neotoma fuscipes fuscipes
Microtus californicus eximius
Microtus californicus aestuarinus
*Rattus rattus rattus**
*Rattus rattus alexandrinus**
Rattus norvegicus norvegicus
Mus musculus
*Erethizon epixanthum epixanthum**
Lepus californicus californicus
Sylvilagus bachmani tehamae
Odocoileus hemionus columbianus

The data for this report have been compiled from a study of 308 specimens, original field notes and observations of my own and those of other workers, unpublished commercial trapping reports made to the California Division of Fish and Game, and published works. Most of the specimens are deposited in the University of California Museum of Vertebrate Zoology; others are in the zoology collection of the Pacific Union College, Angwin, California; collections of the California Academy of Sciences, San Francisco; collections of the Stanford Natural History Museum, Palo Alto, California; and the private collections of Donald Hemphill, Calistoga, California, of E. W. Martin, Palo Alto, California, and of W. M. Longhurst, Napa, California.

I wish to express my appreciation to the persons in charge of the above collections for the privilege of examining specimens from Napa County. I also appreciate the generous assistance I received from others associated with the Museum of Vertebrate Zoology, particularly Dr. E. Raymond Hall, and from Messrs. J. S. Hunter and Gordon H. True of the California Division of Fish and Game, Dr. R. T. Orr of the California Academy of Sciences, and Dr. G. F. Ferris and O. P. Cope of the Stanford Natural History Museum. To many of the residents of Napa County, too numerous to mention here, I am likewise indebted for the valuable information and assistance they gave me.

Under records of occurrence, specimens which are not otherwise listed are deposited in the California Museum of Vertebrate Zoology, University of California, Berkeley.

ACCOUNTS OF SPECIES

Scapanus latimanus caurinus Palmer

California Mole

Scapanus latimanus caurinus Palmer, Jour. Mamm., 18:290, Aug. 14, 1937.

Distribution. Probably over most of County, especially in forests and riparian associations.

Remarks. Mole workings have been noted most often along the margins of wooded streams and on wooded north slopes. In February, 1939, after the beginning of the rains I found workings beneath the litter under *Quercus douglasii* on a south slope, indicating an extension of habitat at this season. Further evidence on this score is furnished by some observations in an orchard beside Huichica Creek in the south-

* Occurrence in Napa County not fully confirmed.

western part of the County, in September, 1939. At this time the ground in the orchard was much drier than that beneath the alder and bay trees on the banks of the stream, and the mole workings were confined to the area immediately under the trees. Within one week after the orchard was irrigated, three separate workings were found in the orchard, one more than 200 feet from the creek. Possibly the water caused earthworms to come nearer the surface, thus making them available to the moles whose runs were usually not more than 6 inches deep. In the summer of 1937, I dug out a mole that I saw working in the garden of my home on Huichica Creek and found that it had been feeding upon a large sand cricket, *Stenopelmatus longispina*.

Records of occurrence. Specimens examined, 15, as follows: Calistoga, 1 (Coll. D. Hemphill); 2 mi. NW St. Helena, 1; St. Helena Sanitarium, 2 (P. U. C.); Howell Mt., 7 (6 P. U. C., 1 Coll. D. Hemphill); Huichica Creek, 1; 2 mi. SW Napa, 1; 2 mi. S Napa, 1.

Sorex trowbridgii montereyensis Merriam

Trowbridge Shrew

Sorex montereyensis Merriam, N. Am. Fauna, 10:79, Dec. 31, 1895.

Sorex trowbridgii montereyensis, Jackson, Jour. Wash. Acad. Sci., 12:264, June 4, 1922.

Distribution. Throughout County in forest and brushland.

Remarks. All records of this shrew are from forested areas or from the edge of chaparral. The two specimens which I collected were taken along Huichica Creek in traps baited with rolled oats. Both were caught on the creek bank; one about twenty feet from the water on open ground beneath a stand of *Quercus douglasii*; the other about thirty feet from the water beneath *Umbellularia californica*. D. Hemphill reports taking them in similar situations along Angwin Creek on Howell Mountain.

Records of occurrence. Specimens examined, 10, as follows: Calistoga, 1 (Coll. D. Hemphill); Howell Mt., 7 (4 P. U. C., 1 Coll. D. Hemphill, 2 M. V. Z.); Huichica Creek, 2 (1 Stanford Univ., 1 M. V. Z.). Additional records: Mt. St. Helena, 2; Mt. Veeder, 16, Jackson (1928:98).

Sorex ornatus californicus Merriam

California Shrew

Sorex californicus Merriam, N. Am. Fauna, 10:80, Dec. 31, 1895.

Sorex ornatus californicus, Jackson, Jour. Wash. Acad. Sci., 12:264, June 4, 1922.

Distribution. Possibly throughout County in forest and brushland.

Remarks. While no specimens of this shrew are known from Napa County, Jackson (1928:169) records one from Glen Ellen,

Sonoma County. This locality falls about 2½ miles from the western boundary of Napa County so it is possible that the range of the species extends into Napa County.

Sorex sinuosus Grinnell

Suisun Shrew

Sorex sinuosus Grinnell, Univ. Calif. Publ. Zool., **10**:187, Mar. 20, 1913.

Distribution. Possibly throughout the salt marshes along the lower part of the Napa River.

Remarks. *Sorex sinuosus* has not been taken in Napa County, but D. Hemphill has one specimen in his collection from 5 miles northwest of Vallejo. The specimen was taken in the salt marshes along the lower part of the Napa River in Solano County, but only half a mile south of the Napa County line. It is logical to assume that these shrews also range into Napa County as the marsh habitat is continuous across the county line.

While this specimen has been placed under *S. sinuosus* which is in the *S. ornatus* group, there are certain characters which resemble those found in the *S. vagrans* group. The high dome-shaped cranium appears almost intermediate between that of *S. sinuosus* and that of *S. v. halicoetes* from the southern end of San Francisco Bay. However, the foramen magnum does not extend as far dorsally as in typical *S. v. halicoetes*, and it does not have the brown colored ears of the latter race. Even though this specimen appears intermediate between *S. sinuosus* and *S. v. halicoetes*, there appears to be little chance of intergradation as *S. v. halicoetes* has never been taken north of the Golden Gate or the Carquinez Straits and previous to this record *S. sinuosus* has never been taken away from its type locality, Grizzly Island, on the north side of Suisun Bay.

Myotis evotis chrysonotus (J. A. Allen)

Golden Long-eared Bat

Vespertilio chrysonotus J. A. Allen, Bull. Am. Mus. Nat. Hist., **8**:240, Nov. 21, 1896.

Myotis evotis chrysonotus, Miller and Allen, Bull. U. S. Nat. Mus., **144**:116, May 25, 1928.

Distribution. Probably throughout County in less heavily forested areas.

Remarks. The one record of this bat for Napa County is a specimen that I took on October 15, 1939, in the basement of my home on Huichica Creek. Apparently the bat had entered through an open cellar door. The animal was active and showed no tendency toward hibernation.

Record of occurrence. Specimen examined, 1, from Huichica Creek.

Myotis thysanodes thysanodes Miller

Fringed Bat

Myotis thysanodes Miller, N. Am. Fauna, **13**:80, Oct. 16, 1897.

Myotis thysanodes thysanodes, Miller and Allen, Bull. U. S. Nat. Mus., **144**:126, May 25, 1928.

Distribution. Probably over most of County in less heavily forested areas.

Remarks. The single specimen of the fringed bat from the County was taken by D. Hemphill. He captured it one evening in August, 1938, when it flew into the auditorium of the Pacific Union College on Howell Mountain.

Record of occurrence. Specimen examined, 1, from Howell Mt. (Coll. D. Hemphill).

Myotis volans longicrus (True)

Long-legged Bat

Vespertilio longicrus True, Science, **8**:588, Dec. 24, 1886.

Myotis volans longicrus, Miller and Allen, Bull. U. S. Nat. Mus., **144**:140, May 25, 1928.

Distribution. Probably throughout County except in more heavily forested areas and salt marshes along lower part of Napa River.

Remarks. Although only one bat of this species has been taken in Napa County, D. Hemphill, who collected it in an old house at Calistoga in June, 1939, told me that he had seen several others of the same kind there at the time. He also stated that he found *Antrozous pallidus pacificus* and *Corynorhinus rafinesquii intermedius* occupying this house. Miller and Allen (1928:140) record one specimen of this bat from Mt. Veeder in Sonoma County, which would be not far from the western boundary of Napa County.

Record of occurrence. Specimen examined, 1, from $\frac{1}{2}$ mi. N. Calistoga (Coll. D. Hemphill).

Myotis californicus caurinus Miller

Little California Bat

Myotis californicus caurinus Miller, N. Am. Fauna, **13**:72, Oct. 16, 1897.

Distribution. Probably throughout County in areas of less heavy forest and brushland.

Remarks. I have observed this bat foraging only along Huichica Creek where it was common throughout August, September and October, 1939. They appeared in the early evening usually about half an hour after sundown and flew erratically back and forth along the margin of trees and brush bordering the creek. They usually stayed

on the east side of the creek, apparently taking advantage of the protection afforded by the trees from the prevailing west wind, and at no time did I observe them flying more than about twenty feet above the ground. In 1937 I found one roosting in the attic of an old winery beside Huichica Creek.

Specimens from Napa County have been referred to the coastal race, *M. c. caurinus*, but they appear to have considerable affinity with the inland race, *M. c. californicus*. Miller (1897:72) distinguishes the two races on the basis of the darker color attained in the humid coast belt, and these specimens appear intermediate in that respect.

Records of occurrence. Specimens examined, 6, as follows: Howell Mt., 1 (P. U. C.); Mont La Salle, 1; Huichica Creek, 4.

Pipistrellus hesperus merriami (Dobson)

Merriam Cañon Bat

Vesperugo merriami Dobson, Ann. Mag. Nat. Hist., ser. 5, **18**:124, Aug., 1886.

Pipistrellus hesperus merriami, Grinnell, Proc. Calif. Acad. Sci., ser. 4, **3**:279, Aug. 28, 1913.

Distribution. Probably throughout County, but especially in the eastern part in less dense forest and brushland.

Remarks. All records of this bat are from east of Napa Valley. Likewise they are from areas of dry chaparral and scattering blue oaks except one from Howell Mountain which is in the arid Transition life-zone.

Records of occurrence. Specimens examined, 9, as follows: Howell Mt., 1 (P. U. C.); Putah Canyon, 8 mi. W Winters, 8.

Eptesicus fuscus bernardinus Rhoads

Big Brown Bat

Eptesicus fuscus bernardinus Rhoads, Proc. Acad. Nat. Sci., Philadelphia, **53**:619, Dec., 1901.

Distribution. Probably throughout County, especially in more open oak forests.

Remarks. Although only one specimen of this bat has been taken, I think that it is one of the commoner species in the County. I have seen them foraging along Huichica Creek in company with *Tadarida mexicana* and *Myotis californicus caurinus*, appearing early in the evening just as the light was beginning to fail. Their slow regular flight, short, broad wings, and large size as compared with the *Myotis* and *Tadarida* distinguished them. Throughout September they were abundant in this area, but none was noted in October, which suggested that they had migrated or hibernated.

Record of occurrence. Specimen examined, 1, from Huichica Creek.

Lasiurus borealis teliotis (H. Allen)

Western Red Bat

Atalpha teliotis H. Allen, Proc. Am. Philos. Soc., 29:5, Mar. 6, 1891.
Lasiurus borealis teliotis, Miller, N. Am. Fauna, 13:110, 1897.

Distribution. I have collected three specimens of the red bat. All of these were flying 15 to 20 feet high along the margin of alders and oaks bordering Huichica Creek. They did not appear until late evening, almost one hour after sunset. Each seemed to have a regular beat along the creek, flying steadily back and forth with only an occasional dart after an insect. Although these bats are said to migrate southward in winter, I collected one on November 23, 1939. Up until that time, however, there had been no heavy rains which might influence them to migrate.

Records of occurrence. Specimens examined, 4, as follows: Huichica Creek, 3; Napa, 1.

Lasiurus cinereus (Peale and Beauvois)

Hoary Bat

Vespertilio cinereus Peale and Beauvois, Catal. Peale's Mus., Phila., 15, 1796.

Lasiurus cinereus, H. Allen, Smithsonian Misc. Coll., 7:18, 1864.

Distribution. Probably throughout County in heavier forests.

Remarks. At late evening in September, 1936, along Huichica Creek, I saw a hoary bat flying about 75 feet above the ground over open grassland, but within 100 yards of an oak forest. It had a steady flight with few dips or changes of direction. I shot it but did not save it as a specimen.

Corynorhinus rafinesquii intermedius H. W. Grinnell

Lump-nosed Bat

Corynorhinus macrotis intermedius H. W. Grinnell, Univ. Calif. Publ. Zool., 12:320, Dec. 4, 1914.

Corynorhinus rafinesquii intermedius, H. W. Grinnell, Univ. Calif. Publ. Zool., 17:342, Jan. 31, 1918.

Distribution. Probably throughout County in areas of less heavy forest and brushland.

Remarks. All records of the lump-nosed bat are from the northwestern part of the County, but because of their wide distribution about other parts of San Francisco Bay and throughout western California, there is no reason to believe that they are limited to this section of Napa County. D. Hemphill has told of finding them roosting in a cave along Angwin Creek and also in an old house near Calistoga. *Antrozous pallidus pacificus* and *Myotis volans longicrus* were found roosting in the same house.

Records of occurrence. Specimens examined, 9, as follows: Calistoga, 6 (2 Coll. D. Hemphill, 4 P. U. C.); Howell Mt., 3 (1 Coll. D. Hemphill, 1 P. U. C., 1 M. V. Z.). Additional records: Mt. Veeder, 1, H. W. Grinnell (1918:342).

Antrozous pallidus pacificus Merriam

Pallid Bat

Antrozous pallidus pacificus Merriam, Proc. Biol. Soc. Wash., **11**:180, July 1, 1897.

Distribution. Probably over entire County, except more heavily forested areas and salt marshes along lower part of Napa River.

Remarks. All records of this bat indicate that it prefers a habitat where there is some brush or trees and also open land. It has not been found in areas of open grassland, salt marshes, or in heavy forest such as the redwood-Douglas fir association. A specimen from along Huichica Creek on September 23, 1939, was shot in the early evening as it flew across an open field. Information from D. Hemphill points to the fact that the pallid bat has two roosting places. He has taken specimens hanging in an old barn at various times in the night, but has been unable to find them there in the day. This might indicate that the bats were only retiring to the barn to roost after foraging in the evening and were using another roost in the day.

Records of occurrence. Specimens examined, 15, as follows: Calistoga, 10 (2 P. U. C., 8 Coll. D. Hemphill); Mont La Salle, 4; Huichica Creek, 1.

Tadarida mexicana (Saussure)

Mexican Free-tailed Bat

Molossus mexicanus Saussure, Rev. et. Mag. de Zool., ser. 2, **12**:283, 1860.

Tadarida mexicana, Miller, Bull. U. S. Nat. Mus., **128**:86, Apr. 24, 1924.

Distribution. Probably over most of County, except salt marshes along lower part of Napa River.

Remarks. The distribution of this bat, as indicated by its records of occurrence, seems to correspond most closely with the oak association. It has not been taken from the salt marshes nor has it been taken from the humid Transition life-zone among the redwoods and Douglas firs. There is some evidence, however, that it may inhabit the more arid transition areas such as the yellow pine and incense cedar forest on Howell Mountain, but the specimens from this locality may have been animals that flew there to forage and that roosted in the adjacent oak association.

I have observed these bats foraging over grassland along Huichica Creek as far as 300 yards from the nearest trees. Their rapid, darting flight and narrow pointed wings distinguished them readily from the *Eptesicus*, *Antrozous* and *Myotis* with which they frequently are asso-

ciated. One colony, located in a crack under the wooden moulding over a door in an old stone winery on Huichica Creek, numbered about twenty individuals. They continued to forage nightly almost until the end of December, 1939, when the heavy winter rains commenced. When observed again on February 4, they were still hibernating, although not entirely dormant, changing roosting places frequently and squeaking occasionally. Several taken alive at this time and placed in a warm room soon became active.

Records of occurrence. Specimens examined, 8, as follows: Howell Mt., 4 (2 P. U. C., 2 Coll. D. Hemphill); Huichica Creek, 4.

Ursus americanus altifrontalis Elliot

Black Bear

Ursus altifrontalis Elliot, Field Columb. Mus., zool. ser., 3:234, June, 1903.

Ursus americanus altifrontalis, Hall, Univ. Calif. Publ. Zool., 30:235, March 2, 1928.

Distribution. Possibly in more heavily forested areas in northern part of County.

Remarks. J. E. Trodden, a fur dealer in Napa, reported seeing "bear sign" in the Mayacamas Mountains west of Calistoga about 1920. He is well qualified to recognize evidence of bears as he has hunted them extensively in Humboldt and Del Norte counties.

Procyon lotor psora Gray

California Raccoon

Procyon psora Gray, Ann. and Mag. Nat. Hist., 10:261, Dec., 1842.

Procyon lotor psora, Mearns, Proc. Biol. Soc. Wash., 27:66, Mar. 20, 1914.

Distribution. Throughout County in forest and brushland and in salt marshes along lower part of Napa River.

Remarks. Raccoons have perhaps the broadest range of habitat of any of the carnivores. They are abundant throughout the brushland and forest and also in the salt marshes; they forage widely throughout the grassland and into more settled parts of the valleys. An idea of their numbers may be gained from the California Division of Fish and Game commercial trapping reports. In the 1938-1939 trapping season, 102 were taken. The striped skunk was the only carnivore taken in greater numbers.

In 1936 I found two dens, one in a hollow live oak and one in a hollow laurel. Another was found in a hole under a rock outcrop in 1937. When this den was revisited in November, 1939, it was found to be occupied by striped skunks.

I have observed on numerous occasions by examining their scats that they commonly feed on cherries and prunes in season.

Records of occurrence. Specimens examined, 3, as follows: Howell Mt., 2 (1 Coll. D. Hemphill, 1 P. U. C.); 10 mi. N Monticello, 1.

Bassariscus astutus raptor (Baird)

Ring-tailed Cat

Bassaris raptor Baird, Mamm. Mex. Boundary, 19, 1859.

Bassariscus astutus raptor, Hall, Univ. Calif. Publ. Zool., 30:46, Sept. 8, 1926.

Distribution. Throughout County in more heavily forested areas.

Remarks: According to information from J. E. Trodden, a fur dealer in Napa, the ring-tailed cat was formerly more abundant in the County than at the present time. He told me of trapping 3 in Soscol Canyon about 1925 and also that he had bought "several" skins trapped on Mill Creek. However, commercial trapping reports of the California Division of Fish and Game show that they are still present, as one was caught by T. A. Clarke of Monticello in the season of 1934-35 and three more were caught by D. Ward of Calistoga in the season of 1937-38.

Records of occurrence. No specimens have been examined from the County. Additional records: Calif. Div. Fish and Game, commercial trapping reports, T. A. Clarke, Monticello, 1, 1934-35; D. Ward, Calistoga, 3, 1937-38.

Mustela frenata munda (Bangs)

Redwoods Weasel

Putorius xanthogenys mundus Bangs, Proc. New England Zool. Club, 1:56, June 9, 1899.

Mustela frenata munda, Hall, Carnegie Inst. Wash. Contrib. Paleo., 473:107, Nov. 20, 1936.

Distribution. Probably over entire County except more settled parts.

Remarks. Although the records of the weasel are from the southwestern part of the County, I have reliable reports of their presence in the vicinity of Napa, Carneros, and Saint Helena. I. Mackenzie claims to have killed one on his ranch, 3 miles northeast of Napa. D. Slack trapped one along an old stone wall, 2 miles north-northwest of Carneros about 1928, and J. Andersen reported seeing "several" in the Napa Valley west of Saint Helena in the summer of 1937. He is well qualified to recognize them as he is familiar with both mink and weasels from his trapping experience in the salt marshes along the lower part of the Napa River. He also obtained the second record for the County, one caught in a mink set in the salt marshes 6 miles south-southwest of Napa. The other record from 4 miles north of Vallejo would fall in an area covered by grassland and scattering live oaks.

Records of occurrence. Specimens examined, 2, as follows: 6 mi. SSW Napa, 1; 4 mi. N Vallejo, 1.

Mustela vison aestuarina Grinnell

California Mink

Mustela vison aestuarina Grinnell, Proc. Biol. Soc. Wash., 29:213, Sept. 22, 1916.

Distribution. Principally in salt marshes along lower part of Napa River, but up river at least as far as Saint Helena.

Remarks. Formerly the mink had a much more extensive range along the upper part of the Napa River than it has today. Most of those above the town of Napa have now been trapped out and the town prevents repopulation from the salt marshes below. J. E. Trodden of Napa, a dealer in raw furs, told me that he knew of mink taken along the river in the vicinity of Saint Helena since 1930. In the salt marshes, however, they are still abundant and I have frequently noted their tracks in the mud at low tide near Edgerley Island. Tracks were always found in the morning after the tide had been low the previous night indicating that mink do their foraging nocturnally. An idea of their abundance may be gathered from the trapping reports made to the Division of Fish and Game for 1939. In this season 67 were reported taken by commercial trappers. One of these trappers, J. Andersen of Cuttings Wharf, told me that he caught 40 in 3 weeks with a trap line of about 75 traps. He also stated that mink would not come to any but fresh bait and that he was using parts of jack rabbit. The fur, according to him, usually became prime near the end of December.

Records of occurrence. Specimens examined, 5, as follows: 6 mi. SSW Napa, 3; 12 mi. SW Napa, 2.

Lutra canadensis brevipilosus Grinnell

River Otter

Lutra canadensis brevipilosus Grinnell, Univ. Calif. Publ. Zool., 12:306, Oct. 31, 1914.

Distribution. Throughout salt marshes along lower part of Napa River.

Remarks. Although I have not found any specimens of otter from Napa County, there are several authentic reports of its presence in the salt marshes of southern Napa County. In his commercial trapping report to the California Division of Fish and Game for the season of 1937-38, S. Cullison of Napa reported taking one. J. E. Trodden, a fur dealer in Napa, told me that he had not purchased any pelts from the County in the last ten years, but previous to that time an occasional one had been brought in. J. C. Slack of Carneros also told of killing five otters in the Napa River marshes while hunting ducks for the market prior to 1915.

Spilogale gracilis phenax Merriam

Spotted Skunk

Spilogale phenax Merriam, N. Am. Fauna, 4:13, Oct. 8, 1890.

Spilogale gracilis phenax, Grinnell, Univ. Calif. Publ. Zool., 40:105, Sept. 26, 1938.

Distribution. Throughout forest and brushland of County.

Remarks. The spotted skunk appears to be much less abundant and is more restricted to the forest and brushland than the striped skunk. I have never observed the species in grassland nor have I seen individuals foraging in the evening as the striped skunks commonly do. On December 25, 1939, about 8 a.m., I flushed a horned owl from a grove of live oaks 3 miles west of Napa and noted that it was carrying the hind quarters and tail of a spotted skunk. The distinct odor lingering about identified it as a skunk, and the small tail with a white tip showed that it was a spotted skunk. Both specimens from Huichica Creek show fenestrations in the frontal bones over the frontal sinuses. According to Seton (1929:348) these are caused by the nematode worm, *Filaroides mustelarum.*

Records of occurrence. Specimens examined, 2, from Huichica Creek.

Mephitis mephitis occidentalis Baird

Northern California Striped Skunk

Mephitis occidentalis Baird, Pac. R. R. Rept., Mammals, 8:194, July 20, 1857.

Mephitis mephitis occidentalis, Grinnell, Univ. Calif. Publ. Zool., 40:106, Sept. 26, 1933.

Distribution. Probably over entire County except salt marshes along lower part of Napa River.

Remarks. The striped skunk shows a decided preference for the lowlands and foothills and is most abundant where the grassland meets the forest or chaparral. One den was found on Huichica Creek under a rock outcrop among a high growth of *Adenostoma fasciculatum.* Two years previously this hole had been occupied by raccoons, but there was no evidence of their presence in November, 1939. On Huichica Creek I observed on three occasions where skunks had dug out the nests of ground-dwelling wasps, probably for the larvae they contained.

Records of occurrence. Specimens examined, 5, as follows: Howell Mt., 2 (P. U. C.); St. Helena Sanitarium, 1 (P. U. C.); Huichica Creek, 2.

Taxidea taxus neglecta Mearns

California Badger

Taxidea americana neglecta Mearns, Bull. Am. Mus. Nat. Hist., 3:250, June 5, 1891.

Taxidea taxus neglecta, Miller and Rehn, Proc. Boston Soc. Nat. Hist., 30:218, Dec. 27, 1901.

Distribution. Probably mostly over southern and eastern parts of County in less forested areas.

Remarks. The only record of a badger within the County is a skull from 3 miles southwest of Napa. It is probable that they were at no time abundant in this area and at the present time there are but a small number surviving. I have seen their workings only twice—once on the east side of Atlas Peak in 1935, and again on November 25, 1939, three fresh holes were observed at the head of Huichica Creek. Here the badger had been digging out ground squirrel burrows in a small valley covered by grassland. J. C. Slack of Napa reports the taking of a badger about 1915 on the Watson ranch near Napa Junction.

Record of occurrence. Specimen examined, 1, from 3 mi. SW Napa.

Urocyon cinereoargenteus townsendi Merriam

Gray Fox

Urocyon californicus townsendi Merriam, N. Am. Fauna, 16:103, Oct. 28, 1899.

Urocyon cinereoargenteus townsendi, Bailey, N. Am. Fauna, 55:286, Aug. 29, 1936.

Distribution. Throughout forest and brushland of County.

Remarks. The gray fox is one of the more numerous carnivores in this area and is found wherever there is forest or brushland. According to the California Division of Fish and Game commercial trapping reports, 17 were taken in the County in the season of 1937-38, and 32 were taken in the season of 1938-39. In the summer of 1937, I observed one foraging about half an hour after daybreak in a brushy canyon 2½ miles west of Carneros. Later in the summer I found a den in a hole among a pile of boulders at the base of a rock outcrop on the west side of this canyon. I have trapped two foxes in this area using parts of jack rabbits for bait. Both were taken among hills covered by oaks and manzanita. L. Picetti of Sonoma, who has hunted them often with hounds, states that when hard pressed they climb trees readily. I observed this behavior on one occasion while hunting with him in western Napa County. The fox after eluding the dogs for some two hours nimbly took refuge in a blue oak, climbing the almost vertical trunk to a crotch about ten feet above the ground.

Records of occurrence. Specimens examined, 4, as follows: Howell Mt., 2 (1 P. U. C., 1 Coll. D. Hemphill); Huichica Creek, 1 (Coll. E. W. Martin); 2 mi. W Carneros, 1. Additional records: California Division of Fish and Game trapping reports as above.

Canis latrans ochropus Eschscholtz

California Coyote

Canis ochropus Eschscholtz, Zool. Atlas, 3:1, 1829.

Canis latrans ochropus, Nelson, Proc. Biol. Soc. Wash., 45:224, Nov. 26, 1932.

Distribution. Mountainous areas of County, in forest and brushland.

Remarks. In Napa County most of the coyotes occur in the Napa Mountains and east thereof. Until about 1930 they were common throughout the Mayacamas Mountains, but beginning about 1929, because of their depredations on livestock in this area they were poisoned and trapped out by men working under the direction of the United States Bureau of Biological Survey. They were scarce or absent in the southern end of this range until 1939. Since then a few scattered individuals were found to be present in this part of the County.

Record of occurrence. Specimen examined, 1, from Carneros Creek.

Felis concolor californica May

California Mountain Lion

Felis californica May, Calif. Game, "Marked down," 22, 1896.

Felis concolor californica, Nelson and Goldman, Jour. Mamm., 10:347, Nov. 11, 1929.

Distribution. Throughout more heavily forested areas of County.

Remarks. Although mountain lions are not as numerous in Napa County as they are to the north in Lake County, there are more present in this area than the bounty reports of the California Division of Fish and Game indicate. Since 1910, only 4 bounties have been collected from Napa County, but in the same period 416 have been collected from Lake County. One explanation for this great difference is that there is much more hunting done in Lake County and more packs of lion dogs are kept there.

Most of the lions in Napa County are concentrated in the northern part of the Napa Range, but a few range as far south as Wildhorse Valley opposite Napa, and some range eastward to the Vaca Mountains. In 1936, I found the tracks of one on the headwaters of Huichica Creek in the southwestern part of the County.

In 1938, J. Manual killed one 2 miles east of Calistoga. He claimed that there were two of them in the vicinity at that time, but that he was able to secure only one.

Record of occurrence. Specimen examined, 1, from 2 mi. E Calistoga (Coll. J. Manual).

Lynx rufus californicus Mearns

California Wildcat

Lynx rufus californicus Mearns, Proc. U. S. Nat. Mus., 20:458, Dec. 24, 1897.

Distribution. In forested areas and brushlands throughout County.

Remarks. From my own observations and from information given me by L. Picetti of Sonoma who has hunted wildcats extensively with hounds in the western part of Napa County, I think that the wildcat's range is strictly limited to areas of forest and chaparral. In the day they usually retire to thickets of dense chaparral, but when foraging they often travel into more open areas, although never far into open grassland. On warm mornings they are commonly found sunning themselves on some ridge or rock outcrop for an hour or two after sunrise. An idea of their numbers may be obtained from the commercial trapping reports to the California Division of Fish and Game. In 1939 fifty-three were taken by state and commercial trappers, but G. H. True of the Division of Fish and Game thinks that this probably represented only about 25 per cent of the total catch. At any rate they ranked fifth among the catch of carnivores in this report, being surpassed by skunk, raccoon, gray fox, and mink.

Records of occurrence. Specimens examined, 2, as follows: Howell Mt., 2 (1 P. U. C., 1 Coll. D. Hemphill). Additional records: Division of Fish and Game trapping report as above.

Zalophus californianus (Lesson)

California Sea Lion

Otaria californiana Lesson, Dict. Class. d'Hist. Nat., 13:420, Jan., 1828.

Zalophus californianus, Allen, Mongr. N. Am. Pinnipedia, 276, 1880.

Distribution. Possibly in Napa River as far up as the town of Napa.

Remarks. Sea lions have been reported from the Napa River on several occasions. S. M. Chan of Napa told me that one was killed in the river some time prior to 1920. J. Andersen of Cuttings Wharf also reported having seen one in Shoal Water Bay, 9 miles south of Napa in 1937.

Although there is no definite proof as to whether these animals were California or Steller sea lions, probably they were the former species which is found commonly in San Francisco Bay.

Citellus beecheyi douglasii (Richardson)

Douglas Ground Squirrel

Arctomys? (Spermophilus?) Douglasii Richardson, Fauna Bor.-Amer., 1:172, 1829.

Citellus beecheyi douglasi, Grinnell, Proc. Calif. Acad. Sci., ser. 4, 3:345, Aug. 28, 1913.

Distribution. Over entire County in valleys and open hills and to edge of salt marshes along lower part of Napa River.

Remarks. Because of their diurnal habits and because they live for the most part on open grassland, ground squirrels are perhaps the most commonly observed rodent in this area. Near my home on Huichica Creek, I kept one colony under observation from October, 1939 until April, 1940.

This colony was located on the west side of the creek on a sloping sidehill covered by grassland, 70 yards below the edge of an oak forest. Between the colony and the creek was a narrow grain field, averaging about 100 yards in width. This field had been planted to barley in the spring of 1939 and there was still much stubble and loose grain scattered about.

In this study I noted certain relationships to predators. On October 1, 1939, a Cooper hawk made an unsuccessful attempt to capture a young squirrel (young of previous spring) which, although struck by the hawk, managed to pull away and reach a hole. During this attack a full grown squirrel sat at the mouth of a burrow 30 yards distant and squeaked defiantly at the hawk. This might indicate that a full grown squirrel had no fear of a hawk of this size or that this particular squirrel was confident that it could reach its burrow safely before being attacked. Squirrels can distinguish hawks from other birds, as I noted when one paid no attention to a flicker flying 30 feet over its head. Red-tailed hawks have a different method of attack. One was seen to alight in an oak tree above the colony. The approach of the hawk sent all of the squirrels down holes, but probably sooner or later one would have ventured out far enough for the hawk to catch it. The success of this method of watchful waiting is apparent when one realizes that squirrels do not ordinarily pay any attention to a motionless object. I have sat motionless within 30 yards of a feeding squirrel which was oblivious of my presence, but the moment I moved it scurried for the nearest hole. At the entrance it paused and gave several loud squeaks, whereupon another squirrel feeding fully 100 yards away sat upright searching for possible danger. This shows a dependency upon each other for warning.

A complete study of hibernation was not made, but a few significant points were noted. Squirrels were out in full numbers until the first week in November. Throughout November their numbers became fewer, until by December they were seen only sporadically on exceptionally warm days. Two weeks of warm dry weather in late January and early February brought them out in greater numbers than at any time since they entered hibernation, but the next heavy rain sent them into their holes again. In November when the squirrels were entering hibernation, it was noted that the young of the year tended to remain out longer than the adults. However, after they had once entered hibernation only adults were seen to come out occasionally.

A specimen collected at this locality on September 22, 1939, had five acorns of *Quercus douglasii* in its cheek pouches. In November at the start of hibernation, hulls of barley and of the fruits of *Aesculus californicus* and *Umbellularia californica* were found about the mouths

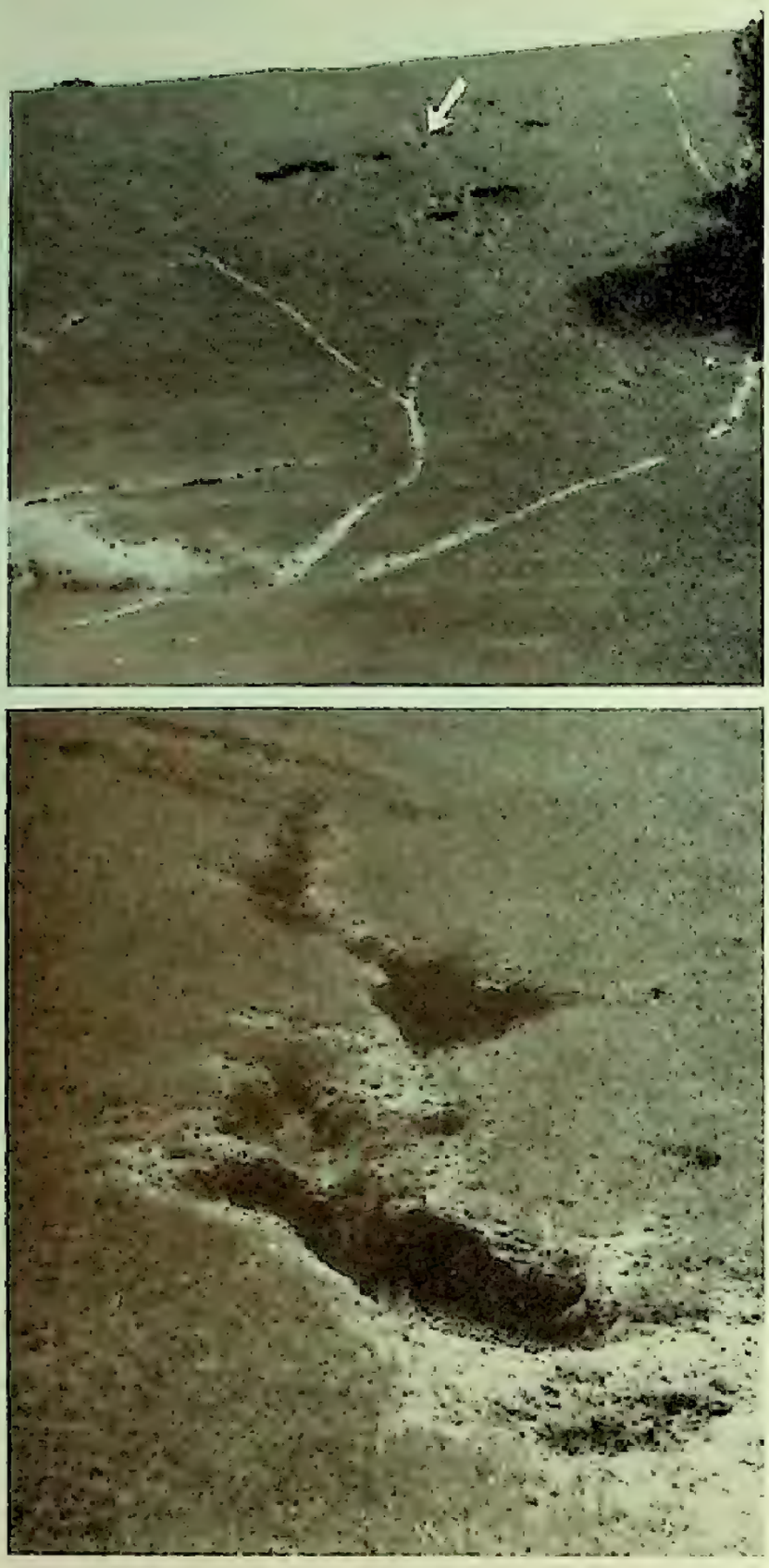


FIG. 98. Above, view of side hill showing erosion caused by rain water flowing through ground squirrel burrows which run with the slope of the hill. Burrows are enlarged by the water until the roof caves in, forming a gully. Well worn sheep trails indicate heavy grazing which accentuates runoff of rain water. Below, close up view indicated by arrow above. Locality: Huichica Creek near Napa—Sonoma Highway. April 21, 1940.

of the burrows. In previous summers I have noted that they ate pears from a nearby orchard.

Along the creek, 200 yards below the colony studied, a pair of burrowing owls (*Speotyto cunicularia hypogaea*) were inhabiting a ground squirrel hole. Squirrels were using another hole 48 yards distant, but were not seen about the hole where the owls stayed.

One of the most important effects of ground squirrels on the land in this area is the formation of gullies. Wherever they dig a hole on a sidehill parallel with the surface of the ground and running for any distance with the slope of the hill, there is a tendency for water to follow it during the heavy winter rains. If sufficient water flows through the hole it will be enlarged, possibly to a diameter of 3 or 4 feet, and when the roof becomes too thin it will cave in leaving a long open trench. Because this trench runs with the slope of the hill, subsequent rain water tends to follow it and by headward erosion it soon becomes a fair sized gully. On 150 acres of hill ground along Huichica Creek, four of these gullies were noted in the process of formation. This type of gully formation was only noted on land which had been heavily grazed by sheep, and it is possible that the runoff of rain water was thereby accentuated, speeding up the process of erosion.

The levying and draining of land at the margins of the salt marshes along the lower part of the Napa River have provided an extension of habitat for the ground squirrels, and they are found there in numbers comparable to those in the nearby hills.

In general it may be said that on wild land ground squirrels do little damage except by starting gully-formation, but on cultivated land, especially orchards and grainfields, they are a definite pest and should be controlled.

Records of occurrence. Specimens examined, 9, as follows: Howell Mt., 7 (P. U. C.); Huichica Creek, 2.

Eutamias sonomae Grinnell

Sonoma Chipmunk

Eutamias sonomae Grinnell, Univ. Calif. Publ. Zool., **12**:321, Jan. 20, 1915.

Distribution. Higher parts of Mayacamas, Napa and Vaca mountains.

Remarks. This chipmunk appears to be nowhere abundant in the County. Probably because of its shy retiring nature, it is seldom observed. The taking of specimens on Mount Saint Helena and Howell Mountain indicates that it favors the higher mountains. Five specimens from Solano County, 3 miles west of Vacaville, suggest that they occur along the Vaca Mountains and therefore in eastern Napa County. Two taken at Eldridge, Sonoma County, likewise suggest their presence in the Mayacamas Range at least as far south as Mount Veeder. Generally their range seems to coincide with the distribution of the conifers such as *Pinus sabiniana*, *Pinus ponderosa*, *Pseudotsuga taxifolia* and *Sequoia sempervirens*.



FIG. 99. Above, habitat of *Citellus beecheyi douglasii*. Below, a more advanced stage in gully formation after a ground squirrel burrow has become enlarged by rain water until the roof has caved in. Indicated by arrow above. Locality: Headwaters of Huichica Creek. May 5, 1940.

Records of occurrence. Specimens examined, 8, as follows: Mt. St. Helena, 2 (C. A. S.); Howell Mt., 6 (4 P. U. C., 2 Coll. D. Hemphill).

Sciurus griseus griseus Ord

Gray Squirrel

Sciurus griseus Ord, Jour. de Physique, de Chimie, d'Hist. Nat. et des Arts, 87:152, 1818 (not seen).

Sciurus griseus griseus, Miller, Bull. U. S. Nat. Mus., 79:332, 1912.

Distribution. In forested areas throughout County.

Remarks. Gray squirrels are not abundant in Napa County. One is fortunate to observe more than two or three in a day's tramp through their habitat. Up until 1936 they were commonly seen along Huichica Creek, but since then their numbers decreased steadily until they were practically absent. Nevertheless, in the spring of 1940 I noted two pairs in this area which might indicate that they were beginning to multiply again. This fluctuation in numbers may be the result of some plague or parasite which becomes effective when they reach a certain degree of abundance.

Formerly I have noted their nests of leaves and twigs in the upper branches of laurel and alder trees along Huichica Creek. Here they commonly fed upon black walnuts in a grove of trees planted near the creek.

Records of occurrence. Specimens examined, 2, as follows: Howell Mt., 2 (P. U. C.).

Thomomys bottae agricolaris Grinnell

Pocket Gopher

Thomomys bottae agricolaris Grinnell, Univ. Calif. Publ. Zool., 40:409, Nov. 14, 1935.

Distribution. Throughout County, principally in grassland.

Remarks. Gophers from Napa County have been referred to the Sacramento Valley race, *T. b. agricolaris*, although in several respects they have affinities with the coastal race, *T. b. minor*. Their wide zygomatic arches, small external auditory meati, white-faced incisors, and ochraceous ventral coloration place them closer to *T. b. agricolaris*, but their darker dorsal color and the fact that their zygomatic arches tend to converge anteriorly, are suggestive of *T. b. minor*.

Gophers have been found most abundantly in cultivated bottom land. In a 40-acre grain field beside Huichica Creek, 21 separate workings were found before the winter rains began in November, 1939. In this field the gophers seemed to be subsisting entirely on the dry roots of the barley plants and upon a few scattering morning glories (*Convolvulus arvensis*) growing there. One burrow system was excavated and the main tunnel was found to be 94 feet long with three side runs, each from 8 to 12 feet in length. There were 41 mounds of earth and 6 feeding burrows where no earth was thrown out. This

system was occupied by an immature female which was caught in the nest cavity at a depth of 23 inches.

Records of occurrence. Specimens examined, 23, as follows: Huichica Creek, 5; 5 mi. SW Napa, 7; 2½ mi. SE Napa, 11.

Perognathus inornatus inornatus Merriam

Pocket Mouse

Perognathus inornatus Merriam, N. Am. Fauna, 1:15, Oct. 25, 1889.

Perognathus inornatus inornatus, Grinnell, Univ. Calif. Publ. Zool., 21:320, Jan. 27, 1923.

Distribution. Possibly throughout eastern part of County in areas of grassland.

Remarks. No records of pocket mice have been found for the County, but they probably occur in the eastern part. Stoner (1933:204) records finding the skull of one in the nest of a burrowing owl near Benicia, in Solano County, and it is somewhat improbable that the owl carried the mouse across the Carquinez Straits from Contra Costa County. There are also specimens from the Sacramento Valley as far north as Sites, Colusa County.

Dipodomys heermanni californicus Merriam

Kangaroo Rat

Dipodomys californicus Merriam, N. Am. Fauna, 4:49, Oct. 8, 1890.

Dipodomys heermanni californicus, Grinnell, Jour. Mamm., 2:95, May 2, 1921.

Distribution. From Napa Valley eastward in close association with chaparral.

Remarks. The kangaroo rat occurs as far west as the Napa Mountains on the east side of the Napa Valley, but becomes more abundant to the eastward and is especially plentiful in the Vaca Range. On the night of September 2, 1939, I counted 11 crossing the road while I drove a distance of 8 miles between Knoxville and Monticello. This area lies on the west side of the Vaca Range and is covered principally by *Quercus douglasii* and *Adenostoma fasciculatum*.

Records of occurrence. Specimens examined, 2, as follows: Howell Mt., 2 (1 P. U. C., 1 M. V. Z.).

Reithrodontomys megalotis longicaudus (Baird)

Long-tailed Harvest Mouse

Reithrodon longicauda Baird, Pac. R. R. Rept., Mammals, 8:451, July 20, 1857.

Reithrodontomys megalotis longicaudus, Grinnell, Proc. Calif. Acad. Sci., ser. 4, 3:303, Aug. 28, 1913.

Distribution. Throughout County, exclusive of more heavily forested areas and salt marshes along lower part of Napa River.

Remarks. The long-tailed harvest mouse has a wide distribution in the grassland and less heavily forested areas throughout the County. Trapping records show only sporadic catches, indicating that it is not abundant nor concentrated in certain habitats, although it seems to prefer the edges of cultivated fields and chaparral interspersed with grassland. It has not been found about dwellings.

Records of occurrence. Specimens examined, 5, as follows: Howell Mt., 2 (P. U. C.); 4 mi. SSE Monticello, 1; Huichica Creek, 2.

Reithrodontomys raviventris halicoetes Dixon

Marsh Harvest Mouse

Reithrodontomys halicoetes Dixon, Univ. Calif. Publ. Zool., 5:271, Aug. 14, 1909.

Reithrodontomys raviventris halicoetes, Howell, N. Am. Fauna, 36:42, 1914.

Distribution. Salt marshes along lower part of Napa River.

Remarks. This harvest mouse ranges throughout the salt marshes from the level of high tide to the edge of the grassland. In late autumn, before the winter rains, it was found most abundantly at the lower edge of the pickle weed (*Salicornia ambigua*) and among growths of *Grindelia cuneifolia*. At this time it was feeding on the green seeds of the *Grindelia*, climbing the bushes, cutting off the flower heads, and tearing them apart on the ground. Traps set throughout the marsh showed that they used the runways of *Microtus californicus aestuarinus*.

Records of occurrence. Specimens examined, 2, as follows: E side Napa River, ½ mi. S. Cuttings Wharf, 2.

Peromyscus maniculatus gambelii (Baird)

Gambel White-footed Mouse

Hesperomys gambelii Baird, Pac. R. R. Rept., Mammals, 8:464, July 20, 1857.

Peromyscus maniculatus gambeli, Osgood, N. Am. Fauna, 28:67, Apr. 17, 1909.

Distribution. Probably over entire County, except salt marshes along lower part of Napa River.

Remarks. The Gambel white-footed mouse has perhaps the widest distribution of any mammal in the County. Although it is most numerous in forest, brushland, or riparian associations, it has often been taken in open grassland, cultivated land, and about buildings. Trapping records in its habitats show that more of them were taken than of all other species together. It was noted that the proportion of white-footed mice to house mice (*Mus musculus*) caught in a hay

barn on Huichica Creek became higher in the late autumn and winter, indicating a migration to this source of food from the surrounding fields when food there became relatively scarce. In most cases the damage done about buildings is negligible, but together with the house mouse and the Norway rat (*Rattus norvegicus norvegicus*) it sometimes becomes very destructive to stored grain or other feed especially when it is in sacks.

Records of occurrence. Specimens examined, 26, as follows: Mt. Mill Hotel, 10 (C. A. S.); Howell Mt., 12 (P. U. C.); Huichica Creek, 4.

Peromyscus boylii boylii (Baird)

Boyle White-footed Mouse

Hesperomys boylii Baird, Proc. Acad. Nat. Sci. Phila., **7**:335, Apr. 1855.

Peromyscus boylii boylii, Miller, Bull. U. S. Nat. Mus., **79**:157, Dec. 31, 1912.

Distribution. Possibly in northern and eastern parts of the County in forest and brushland.

Remarks. Although no specimens of this white-footed mouse have been found for the County, 3 specimens from 3 miles west of Vacaville, Solano County, indicate that their range extends to the southern end of the Vaca Range and therefore in eastern Napa County. However, they probably also have a wide distribution over the northern part of the County as there is more suitable habitat for them in that area. A specimen from Stubbs, Lake County, would tend to substantiate this.

Peromyscus truei gilberti (Allen)

Gilbert White-footed Mouse

Sitomys gilberti Allen, Bull. Am. Mus. Nat. Hist., **5**:188, Aug. 18, 1893.

Peromyscus truei gilberti, Osgood, N. Am. Fauna, **28**:169, April 17, 1909.

Distribution. Throughout wooded parts of County.

Remarks. Even though not as abundant as the Gambel white-footed mouse, the Gilbert white-footed mouse is widely distributed in forested areas and brushland. It has not been taken in grassland, but it does follow stream courses where they are wooded. There is apparently considerable dispersal after the beginning of the winter rains. Trap lines set at this time in more open woodland and chaparral yielded numerous catches while in the early autumn most were taken on heavily forested north slopes.

Records of occurrence. Specimens examined, 74, as follows: Mt. St. Helena, 5 (C. A. S.); Mt. Mill Hotel, 2 (C. A. S.); 5 mi. NW Calistoga, 8; 4 mi. N Calistoga, 43; Calistoga, 2 (Coll. D. Hemphill); Howell Mt., 4 (P. U. C.); 4 mi. SSE Monticello, 8; 5 mi. NW Napa, 1; Huichica Creek, 1.

Neotoma fuscipes fuscipes Baird

Dusky-footed Wood Rat

Neotoma fuscipes Baird, Pac. R. R. Rept., Mammals, 8:495, July 20, 1857.

Neotoma fuscipes fuscipes, Goldman, N. Am. Fauna, 31:87, Oct. 19, 1910.

Distribution. Throughout the County in heavy forest and chaparral.

Remarks. There is a striking difference in abundance between the subspecies of wood rat, *Neotoma fuscipes annectens*, south of San Francisco Bay and this form to the north. Although they occupy essentially the same habitat on heavily wooded streams and north slopes in heavy chaparral, the northern race never seems to occupy a given area completely. Usually houses are scattered; only two or three are found in the same vicinity and few are built in trees as is the common practice of the southern race. Many apparently suitable localities are entirely unoccupied.

Records of occurrence. Specimens examined, 16, as follows: Mt. Mill Hotel, 3 (C. A. S.); Calistoga, 1 (Coll. D. Hemphill); Howell Mt., 12 (P. U. C.). Additional records: Mt. St. Helena, 4; Mt. Veeder, 6; Mt. George, 8, Goldman (1910:89).

Microtus californicus eximius R. Kellogg

Sanhedrin Meadow Mouse

Microtus californicus eximius R. Kellogg, Univ. Calif. Publ. Zool., 21:12, Dec. 28, 1918.

Distribution. Probably throughout most of County, except salt marshes along lower part of Napa River.

Remarks. Nowhere within the County has this meadow mouse been found to be abundant. It exists in the uplands, preferably in the grassland, but near the edge of forest, brush or riparian associations. Large colonies have not been found, workings are scattered, and generally but a single individual is trapped in one locality. During the dry season they concentrate more about springs or along streams, especially where there is a high growth of *Carex*, but in the winter they disperse when there is green feed everywhere.

I think that there is little chance of intergradation with the salt marsh race (*Microtus californicus aestuarinus*) because at no point does the riparian or brushland association extend to the area of *Salicornia ambigua*, with which the salt marsh race is so closely associated.

The ectoparasite, *Hoplopleura acanthopus acanthopus*, has been identified from a specimen taken on Huichica Creek in September, 1939.

Records of occurrence. Specimens examined, 7, as follows: Mt. St. Helena, 1; Calistoga, 1 (Coll. D. Hemphill); Howell Mt., 2 (P. U. C.); St. Helena Sanitarium, 1 (P. U. C.); Huichica Creek, 2.

Microtus californicus aestuarinus R. Kellogg

Tule Meadow Mouse

Microtus californicus aestuarinus R. Kellogg, Univ. Calif. Publ. Zool., **21**:15, Dec. 28, 1918.

Distribution. Salt marshes along lower part of Napa River.

Remarks. The habitat of the tule meadow mouse is sharply defined by the limits of the pickle weed (*Salicornia ambigua*) in the salt marshes along the lower part of the Napa River. Within the *Salicornia* it develops an extensive series of runways and burrows, extending from the level of high tide to the edge of the grassland. Definite colonies do not appear to exist, the population seemingly being made up of individuals rather evenly distributed over all available habitat.

Records of occurrence. Specimens examined, 2, as follows: E side Napa River, ½ mi. S Cuttings Wharf, 2.

Rattus rattus rattus (Linnaeus)

Black Rat

[*Mus*] *rattus* Linnaeus, Syst. Nat., ed. 10, 1:61, 1758.

Rattus rattus rattus, Grinnell, Univ. Calif. Publ. Zool., **21**:319, 1923.

Distribution. Possibly throughout County, especially in more settled areas.

Remarks. No specimens of the black rat have been taken from the County, but because of its wide distribution about San Francisco Bay and northern California it is probable that it occurs here.

Rattus rattus alexandrinus (Geoffroy)

Roof Rat

Mus alexandrinus Geoffroy, Catal. Mammif. du Mus. Nat. d'Hist. Nat., Paris, 192, 1803.

[*R*]*attus rattus alexandrinus*, Hinton, Jour. Bombay Nat. Hist. Soc., **26**:63, Dec. 20, 1918.

Distribution. Possibly throughout the County, especially in more settled areas.

Remarks. Although no specimens of roof rat have been taken from the County, their wide distribution throughout the State indicates that they are probably present in this area.

Rattus norvegicus norvegicus (Erxleben)

Norway Rat

[*Mus*] *norvegicus* Erxleben, Systema Regni Animalis, 1:381, 1777. (Not seen.)

Rattus norvegicus norvegicus, Argyropulo, Zeitschr. f. Saugetierkunde, 2:140, 1928.

Distribution. Probably throughout County, especially about buildings.

Remarks. While Norway rats are most abundant about the more settled parts of Napa County, they are also widely distributed along the Napa River and particularly in the salt marshes along its lower course. There they frequent the levees, feeding to some extent on the black mussels, *Mytilus edulis*, which abound along the banks of the river.

Records of occurrence. Specimens examined, 2, as follows: Howell Mt., 1 (P. U. C.); St. Helena Sanatarium, 1 (P. U. C.).

Mus musculus Linnaeus

House Mouse

Mus musculus Linnaeus, Systema Naturae, ed. 10, 1:62, 1758.

Distribution. Probably over entire County, except salt marshes along lower part of Napa River.

Remarks. As its name implies, the house mouse is found most abundantly about habitations. However, scattering individuals are found in most types of habitat and I suspect they may even invade the salt marshes following the levees and higher ground because these mice are found in this situation in the salt marshes near Palo Alto at the south end of San Francisco Bay. This mouse because of its close association with man is one of the most destructive. I have noted that they do much damage about barns and granaries where they gnaw holes in sacks causing the grain or other feed to be spilled.

Records of occurrence. Specimens examined, 6, as follows: Howell Mt., 5 (P. U. C.); Huichica Creek, 1.

Erethizon epixanthum epixanthum Brandt

Yellow-haired Porcupine

Erethizon epixanthus Brandt, Mem. Acad. Imp. Sci., St. Petersbourg, ser. 6, 3:390, 1835.

Erethizon epixanthum epixanthum, Grinnell, Proc. Calif. Acad. Sci., 3:344, 1913.

Distribution. Possibly throughout northern part of County in coniferous forests.

Remarks. Mrs. J. Manual reported shooting one in 1934 that was treed by her dogs on her ranch 2 miles east of Calistoga. The dogs received many of its quills in their noses when they grabbed the porcupine as it fell from the tree. I do not know if the animal was transported to this locality or occurred here naturally.

Lepus californicus californicus Gray

California Jack Rabbit

Lepus californica Gray, Mag. Nat. Hist. (Charlesworth's), 1:586, 1837.

Lepus californicus californicus, Grinnell, Dixon and Linsdale. Univ. Calif. Publ. Zool., 35:545, Oct., 1930.

Distribution. Probably over entire County except salt marshes along lower part of Napa River.

Remarks. Jack rabbits are widely distributed over the entire County and are especially abundant in the grassland, but more especially where the grassland joins the brushland.

Rabbits forage mostly at night, but come out of their forms in the early evening and often remain out in the early morning until after daylight. They congregate in numbers about any source of green feed, particularly in the summer time when most of their forage has dried up. In August I have seen them feeding on bare plowed ground where the only feed was a few green morning glory plants (*Convolvulus arvensis*). Economically they are of little importance in this area. Occasionally they attack young fruit trees or young vineyards, but they are not present in sufficient numbers to cause a great amount of damage.

Records of occurrence. Specimens examined, 3, as follows: Howell Mt., 2 (P. U. C.); Huichica Creek, 1.

Sylvilagus bachmani tehamae Orr

Brush Rabbit

Sylvilagus bachmani tehamae Orr, Proc. Biol. Soc. Wash., 48:27, Feb. 6, 1935.

Distribution. Generally throughout forest and brushland of County, but prefers riparian associations.

Remarks. In contrast to the race of brush rabbits (*S. b. macrohinus*) occurring south of the Carquinez Straits, *S. b. tehamae* is confined more closely to riparian associations and is rarely found in chaparral or forest. Within the County there is considerable variation. Specimens from Howell Mountain are more typical of true *S. b. tehamae*, whereas a population on a small area of high ground along the lower part of the Napa River, covered by *Baccharis douglasii* and *Quercus agrifolia* and surrounded by salt marsh, showed affinities toward *S. b. riparius* and *S. b. ubericolor* according to R. T. Orr (in litt.). Their large size is suggestive of *S. b. ubericolor*, but their curved rostrum resembles *S. b. riparius*. There is a possibility that the somewhat similar marsh habitat of the two forms may have influenced them toward convergence, as there is very little chance of intergradation and because specimens that are intermediate geographically do not show this tendency.

Records of occurrence. Specimens examined, 8, as follows: Howell Mt., 3 (P. U. C.); E side Napa River, ½ mile S Cuttings Wharf, 5.

Odocoileus hemionus columbianus (Richardson)

Black-tailed Deer

Cervus macrotis, var. *Columbiana* Richardson, Fauna Bor.-Amer., 1:257, 1829.

Odocoileus hemionus columbianus, Cowan, Calif. Fish and Game, 22:215, July, 1936.

Distribution. Throughout entire County except more settled parts of valleys and salt marshes along lower part of Napa River.

Remarks. There are many black-tailed deer within the County. According to J. S. Hunter of the California Division of Fish and Game (in litt.), about 72 per cent of the County provides a suitable habitat, especially the mountains of the Mayacamas, Napa and Vaca ranges. Generally their distribution coincides with that of brush-land and forest. Deer are plentiful over most parts of their range and I have seldom spent a day in the hills without encountering them. In August, 1938, I counted 47 in one day in the hills at the south end of Capell Valley. The kill for the 1939 hunting season, August 1 to September 15, as reported by the Division of Fish and Game, was 918 males with antlers of two points or more. Because only males may be killed, the ratio between the sexes is highly overbalanced, and I estimate that in Napa County there are ten females for every male over two years old. The breeding season begins in late September and extends into November. On November 4, 1939, I encountered a large buck on Mount Veeder with his neck still swollen from the rut. Because the bucks are polygamous, the disproportionate ratio of the sexes has little effect on the number of offspring produced; I have noted but few barren does. A large proportion of the breeding is performed by yearling bucks, both because they are more active than the older bucks and because they remain with the does more constantly in the summer and thus at the start of the rut they are more likely to be present.

Deer obtain most of their food by browsing. I have often seen them feeding on the leaves of *Rhus diversiloba* in the hills at the southern end of the Mayacamas Range. They show a great fondness also for cultivated fruit—apples, pears, grapes, and prunes are some of their favorites. Where orchards and vineyards are adjacent to hill land, deer frequently make serious inroads upon them. On Huichica Creek in 1937 more than 50 per cent of a five-acre orchard of young pear trees was destroyed.

The ectoparasite, *Lipoptena depressa*, was identified from a buck taken on Carneros Creek in August, 1939.

Records of occurrence. Specimens examined, 8, as follows: Monticello, 1; Wooden Valley, 1; Mt. Veeder, 1; Carneros Creek, 1; Huichica Creek, 6 (4 Coll. Wm. Longhurst, 2 M. V. Z.). Additional records: St. Helena, 2, Cowan (1936:824).

LITERATURE CITED

Cowan, Ian McTaggart.
1936. Distribution and variation in deer (genus *Odocoileus*) of the Pacific coastal region of North America. California Fish and Game, vol. 22, pp. 155-246, 13 figs.

Goldman, E. A.
1910. Revision of the wood rats of the genus *Neotoma*. North American Fauna, no. 31, 124 pp., 8 pls., 14 figs.

Grinnell, H. W.
1918. A synopsis of the bats of California. University of California Publications in Zoology, vol. 17, pp. 223-404, 11 pls., 24 figs.

Jackson, H. H. T.
1928. A taxonomic review of the American long-tailed shrews (genera *Sorex* and *Microsorex*). North American Fauna, no. 51, 238 pp., 13 pls., 24 figs.

Miller, G. S., Jr.
1897. Revision of the North American bats of the family Vespertilionidae. North American Fauna, no. 13, 135 pp., 3 pls., 40 figs.

Miller, G. S., Jr., and Allen, G. M.
1928. The American bats of the genera *Myotis* and *Pizonyx*. U. S. National Museum. Bulletin, no. 144, 218 pp., 1 pl., 13 maps.

Seton, E. T.
1929. Lives of game animals. Garden City, N. Y., Doubleday, Doran and Co., vol. 2, 743 pp., 101 pls., 13 maps.

Stoner, E. A.
1933. Some subsistence items of western burrowing owls. Condor, vol. 35, p. 204.

PLANTING FOR CALIFORNIA WILDLIFE [1]

By A. C. Hawbecker
Junior Biologist
U. S. Soil Conservation Service

For several years the statement has been made with increasing frequency that numbers of game birds depend much more on food and cover in adequate amounts and close together than on presence or absence of predators, artificial stocking, or even shooting (unless the latter is so heavy as to constitute overshooting).

In other words, given enough food close to enough suitable cover, various kinds of quail will stand almost anything, whereas lacking these two basic requirements, no amount of pampering in other respects will enable them to get along satisfactorily. Among the many who have recently upheld this view are Leopold (1936), Errington and Hamerstrom (1936) and Sumner (1935). The scarcity of quail today in many parts of California is believed in large part to be the result of human interference with food and cover plants, in some cases unavoidable, but frequently the result of lack of knowledge in the complex field of biology.

This belief in the dependence of wildlife on food and cover plants has been reached mainly by comparing numbers and kinds of birds and mammals on areas with different types and amounts of vegetation. Observations made the other way around, that is, observing the changes in wildlife on an area as a result of planting food and cover plants there, are rare, and there are few published accounts of such studies.

Since soil conservation and wildlife conservation both depend very largely on reestablishment or maintenance of vegetation, the Soil Conservation Service is in an excellent position to help wildlife in the course of its cooperative work with land owners. Small areas such as fence corners, fence rows, badly eroded spots, and gullies are planted to trees, shrubs and vines, often creating cover in areas once entirely devoid of it. Agronomic practices such as strip cropping and cover cropping have benefited wildlife by furnishing food and cover. Probably the greater accomplishment is the enlightenment of the farmer and stimulation of his interest in wildlife. In the plan for conservation of the soil prepared for the farm, the value to wildlife of certain plantings and farm practices is pointed out and the farmer is asked to agree to maintain these areas for that purpose. Talks at farm center meetings and to future farmer groups also help in bringing attention to the value of wildlife conservation.

An example which it has been possible to study with some care is the Morse Ives farm in the San Andreas District, about five miles west of Watsonville, California. The farm is on rolling land bordering Monterey Bay.

[1] Submitted for publication, January, 1940.

As far as can be determined, the original cover was grassland, with possibly some brush and occasional trees. The soil is predominantly highly erodible sandy loam, of which about 120 acres are on slopes ranging from 3 to 25 per cent. When first turned the soil was quite



FIG. 100. The area to be planted on the Ives farm near Watsonville, California, photographed December 5, 1936. Trees planted in 1932 in background. Note that even the volunteer annual vegetation is sparse and poor, consisting very largely of mustard (*Brassica* sp.) and wild radish (*Raphanus* sp.), plants of minor value to quail. No quail were present.

fertile, but as it was farmed intensively and in a manner that accelerated erosion, it soon became rather infertile. At this time the numbers and species of wildlife were few.

The present owner decided that the rapidly declining yield was rendering the upper 120 acres unprofitable and that soil washing down from it was injuring a valuable field below. In 1932 he planted a few portions of this area, mostly to Monterey pines. In January, 1937, after this original planting had reached an appreciable size (see Fig. 100), the rest of the 120 acres was planted to trees and shrubs in cooperation with the U. S. Soil Conservation Service. The area was planted for the purpose of providing the badly eroded land with a vegetative cover, but the particular plants used and the arrangement of them in the plantation were planned for the benefit of wildlife in general, and particularly of quail. Openings were left for food-producing grasses and weeds, and the whole area was basin-listed to minimize run-off and conserve moisture for the benefit of the plantings. About 50,000 trees and shrubs of 19 species were used, from 50 to 8,000 of each kind. The survival was from 0 to 90 per cent, averaging about 50 per cent, so that about 25,000 plants of 17 species were left at the end of the third growing season. The most important surviving species are Monterey and knob-cone pines, Arizona cypress, lemonade berry, laurel sumac, and blue blossom (*Ceanothus thyrsiflorus*).

On March 3, 1937, two months after the Soil Conservation Service had finished planting (see Fig. 101), an agent of the California Division of Fish and Game released seven quail on the farm. Ordinarily this might have been considered "jumping the gun" somewhat because the only available permanent cover was offered by the few trees planted in 1932, and food near this cover was exceedingly scarce. However, the annual growth of mustard, radish, lupine, vetch, wild oats, poppy, tarweed, and other plants was better than in previous seasons, perhaps because of the basin listing, and some, at least, of the quail survived and bred.

In the late fall of 1937, a covey of about 15 quail was in residence on the farm and most of them survived the winter. The original planting, supplemented by California coffeeberry and coyote brush that had sprung up with the original material, supplied cover, and annual material grew up again with the fall rains and became even more rank than in the year before.

That there was still not room for many quail (*i.e.*, the carrying capacity of the range was still small) is shown by the fact that in the fall a number of bunches of quail feathers was found, indicating kills by predatory mammals or birds. After the initial decline in numbers



FIG. 101. Plantation area basin-listed and planted. The basins hold the water and increase infiltration into the ground. Seven quail had been planted. In the two months after this photograph was taken there was a considerable growth of annual, food-producing weeds, which also afforded a small amount of escape cover. Photographed April 2, 1937.

of quail, however, the covey went through the winter with scarcely any losses.

During May, 1938, several mated pairs were seen, and though no nests were found, young were seen later and the size of the covey more than doubled.

A census taken during the fall of 1938 (see Fig. 102) showed a population of approximately 40 California quail on the 120 acres. No live pheasants were found but a few molted feathers were picked up, indicating that the birds were present at least part of the time. This



Fig. 102. Plantation area as it appeared on October 31, 1938. About 40 quail present. Annual vegetation tall and dense. Small conifers are nearly large enough to act as minimal escape cover. The extensive openings between the groups of trees for weeds and other food plants are not clearly shown in the photographs, but are a very important part of the planting plan.

year (1939) a quail nest was found on the farm and young were again seen, but the rise in population was small, only 47 quail having been counted in October. It appears that a maximum population has been approached for the food and cover conditions present (see Fig. 103) and until the later planted trees and shrubs grow larger, the quail population possibly will not increase much.

The very low rainfall of the winter of 1938-39 affected the growth of both annuals and perennials and may have affected the supply of food for quail directly. More normal precipitation might have allowed a further increase. A November population of one bird to three acres is fairly satisfactory, but as food and cover conditions improve with the growth of the plants we may safely expect this figure to increase still more. It should be emphasized that this increase in quail has occurred apparently without any but the initial planting (the nearest quail present were a considerable distance from the farm), without any predator control, and without elimination of the ground squirrels, though they have been gassed from time to time. There has been some hunting, so the birds have been subject to the same conditions as other quail.

Another point frequently stressed by students of wildlife management is that conditions favorable to one kind of wildlife are favorable to many. This is very clearly shown by observations on the Ives farm.

Although we have no records of the wildlife present on the farm before 1937, we have an even better check in adjacent and neighboring farms which are still intensively farmed and are in the condition the Ives farm was in 1932. This sort of check enables us to discount variation in weather and other factors that change from year to year.

A number of species of birds have moved into the planted area, using the original planting for nesting and cover and finding most of their food among the annual vegetation. This year (1939) six adult pheasants and eight young have been seen. A dove nest with two eggs was found in a Monterey pine near the center of the planting. Quite a number of birds of several species nested in the original planting and on the ground this year. Of these the house finch was the most common. The final record for 1939 was a white-tailed kite which appears to have taken up its winter residence in a row of pines. Certain mammals have also come in or increased. Cottontails and California jack rabbits became fairly numerous where there were none or few before. Other wildlife changes that have occurred are indicated in the accompanying table. No damage to the plantation by the rabbits has been noted.

One of the interesting sidelights of the study is the apparent effect of the basin listing on the rodent population. The first two rainy seasons the basins were frequently filled and the rodents were apparently



FIG. 103. Plantation area on August 1, 1939. About 47 quail present. Though the conifers are larger and shrubs have begun to produce seed, the past dry season has caused a lighter, more spotty growth of weeds and grass than in previous years.

drowned out, as the population was very low. The winter of 1938-39 was comparatively dry and the basins did not collect water. The rodent population is now quite high. A check on this will be made during the coming rainy season. If the premise is right, a normal or

wet year will lower the population materially whereas a dry one will allow the population to remain high.

It is planned to continue observations on this farm, and we should eventually have a complete picture of the results of this sort of planting on this type of area.

ANIMAL SPECIES ON IVES FARM BEFORE AND AFTER PLANTING

Birds	*Before* *	*After* **
Turkey Vulture	X	X
White-tailed Kite		X
Sharp-shinned Hawk	X [1]	X [1]
Western Red-tailed Hawk	X	X
Marsh Hawk	X [1]	X [1]
Eastern Sparrow Hawk	X	X
California Quail		X [2]
Pheasant		X
Western Mourning Dove	X [1]	X [2]
Barn Owl		X
Western Burrowing Owl	X	X
Allen Hummingbird		X [2]
Horned Lark subspecies	X [1]	X
California Shrike		X [2]
Western Meadowlark		X
Red-winged Blackbird subspecies	X	X
Bullock Oriole		X
Brewer Blackbird	X	X [2]
Grinnell House Finch		X [2]
Willow Goldfinch		X [2]
California Brown Towhee		X [2]
Savannah Sparrow subspecies		X [2]
Nuttall Sparrow		X [2]
Golden-crowned Sparrow		X
	10 species	24 species

X = present; X [1] = occasional; X [2] = nest found.
* Adjacent bare fields used for "before" census.
** 1938 or 1939 or both.

Birds not listed in column 1 undoubtedly occurred on the farm before the plantation was established, and occur now on adjacent farms, but so occasionally and in such small numbers that their presence has not been noted. Trees planted in 1932 were used by tree-nesting birds.

Mammals	*Before*	*After*
Beechey Ground Squirrel	X	X
California Coast Pocket Gopher	X	X
Long-tailed Harvest Mouse		X
California Meadow Mouse		X
California Jack Rabbit		X
Cottontail (and Brush Rabbit?)		X

REFERENCES

Errington, P. L., and Hamerstrom, F. N., Jr.

1936. The northern bob-white's winter territory. Iowa Agricultural Experiment Station: Research Bulletin, No. 201, pp. 301-443.

Leopold, Aldo

1936. Game management. New York, Charles Scribner's Sons. 481 pp.

Sumner, E. L., Jr.

1935. A life history of the California quail with recommendations for its conservation and management. California Fish and Game, Vol. 21, pp. 167-256, 275-342.

Note by R. M. Bond, Regional Biologist, Pacific Southwest Region, U. S. Soil Conservation Service: Mr. Hawbecker's interesting presentation gives the facts to date on one wildlife planting made by the U. S. Soil Conservation Service. The Service has made many other wildlife plantings, or assisted land owners to make them, in many places in California within the past five years. The planting on the Ives farm is not necessarily the best, but it is the one on which we have the most information. Some of the earlier plantings are now much used by wildlife, but our knowledge of wildlife present in the areas before the planting is inadequate for comparison. Other plantings are so situated that the Soil Conservation biologists can not visit them often enough for intensive study. But the main reason that few examples of the results of planting for wildlife can be presented by the Service at the present time is that our plants are usually not watered or cared for like orchards and crops and, especially on badly eroded soils and in gullies where most of the plantings have been made, they grow so slowly that even five years is not long enough to supply adequate wildlife food and cover. Soil Conservation Service biologists expect to wait another five years before they can accurately evaluate the effectiveness of their planting program in California for game and other wildlife, but if the results on the Ives farm are a sound indication, the program looks extremely promising.

DEATH COMES TO A SEA OTTER [1]

By Edna M. Fisher
San Francisco State College

In December of 1939, a southern sea otter, *Enhydra lutris nereis*, died at sea from natural causes and was washed ashore on the coast of Monterey County. The body was carefully examined for any external marks that might give a clue to the cause of death but none could be found. A slight bleeding along one side of the mouth indicated there were internal injuries of some kind.



Fig. 104. Full length view of sea otter, right side. Photograph by Mr. Rogers, reproduced by courtesy of California Academy of Sciences.



Fig. 105. Hind feet of sea otter, ventral view. Photograph by Edna M. Fisher.

[1] Submitted for publication, February, 1940.

This animal appeared to have been in excellent health, the fur was in good condition and the animal seemed to be normally fat. The body is that of a young male, a subadult, that is, it is of adult size but the bones are not as mature as those of an adult.

The color of this animal is very dark or blackish brown with very few white hairs sprinkled over the body. The head proper is quite light, and there is a light spot on the chest between the two paws or arms. The under side of the tail contains many white hairs and the upper side practically none. Since the sea otter spends most of its time resting on its back, it is the exposed surface of the tail that contains the white hairs.

The total length of the present specimen is 1312.5 mm. (52½ in.). The tail is 256.25 mm. (10¼ in.) from the base to the fleshy tip on the

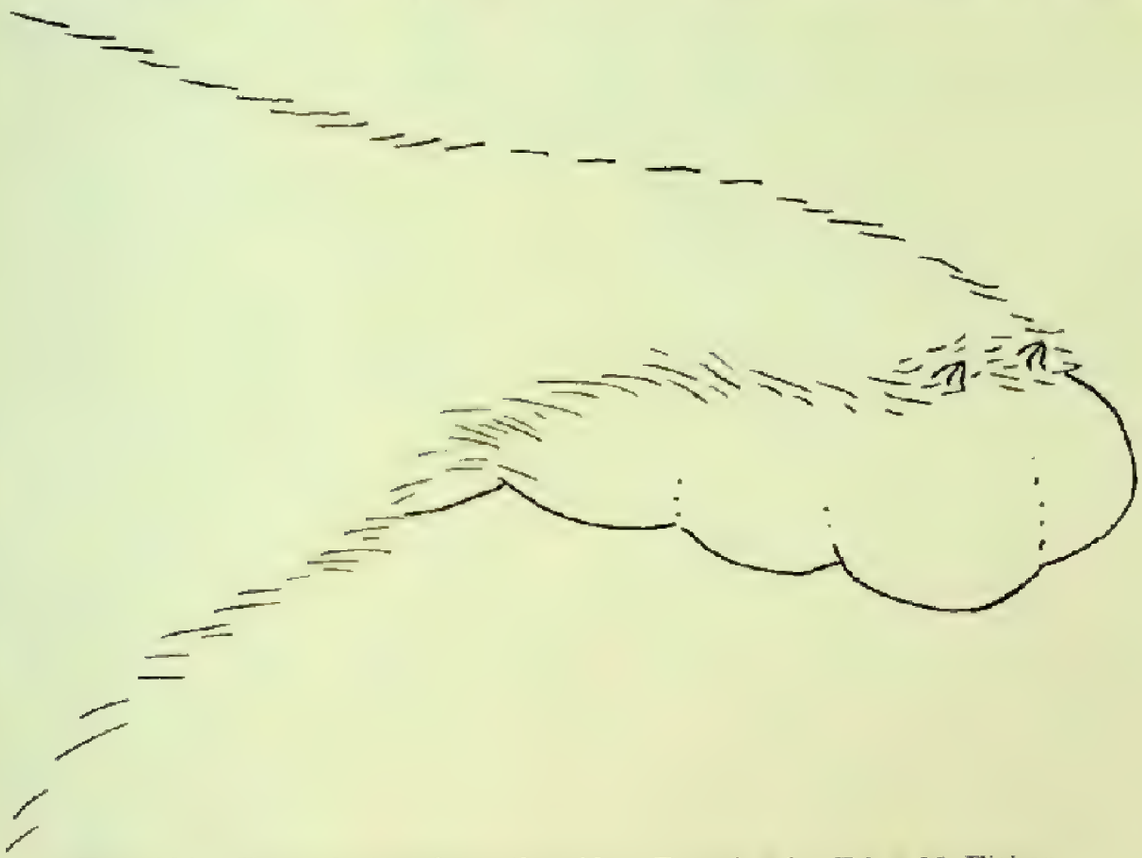


FIG. 106. Paw of otter from the side. Drawing by Edna M. Fisher.

dorsal side, and from the anus to the fleshy tip it measures 225.0 mm. (9 in.), and it is 75.0 mm. (3 in.) wide at the base and only 35.0 mm. (1⅜ in.) in thickness at the base. The tail is most decidedly flattened for its entire free length. The real base of the tail is incorporated with the pelvic region and its well-developed musculature.

The hind foot shows many specializations and changes from the general plan. The foot is webbed to the tips of all the toes and both surfaces are heavily furred. The fur on the feet is shorter and stiffer than that on the legs or the rest of the body. The naked skin areas have been reduced to five small spots occurring on the under surface of each toe, just below the short claw. The fifth or outside toe is the longest and the first is the shortest. The foot when folded has a length of 150.0 mm. (6 in.) and when extended measures 170.0 mm. (6¾ in.) along the line of the fifth toe. When the foot is folded it

is 100.0 mm. (4 in.) wide across the tips of the toes, and when expanded or stretched it reaches 187.5 mm. (7½ in.) and it seems quite probable that the living animal could stretch it even farther.

The ear measures 35.0 mm. (1⅜ in.) from tip to the deeper base, while only 25.0 mm. (1 in.) from the tip to the level of the skin. The ears are covered with black skin bearing few hairs, they are tubular in shape with a very rounded tip, and in life they barely extend beyond the level of the fur when it is dry.

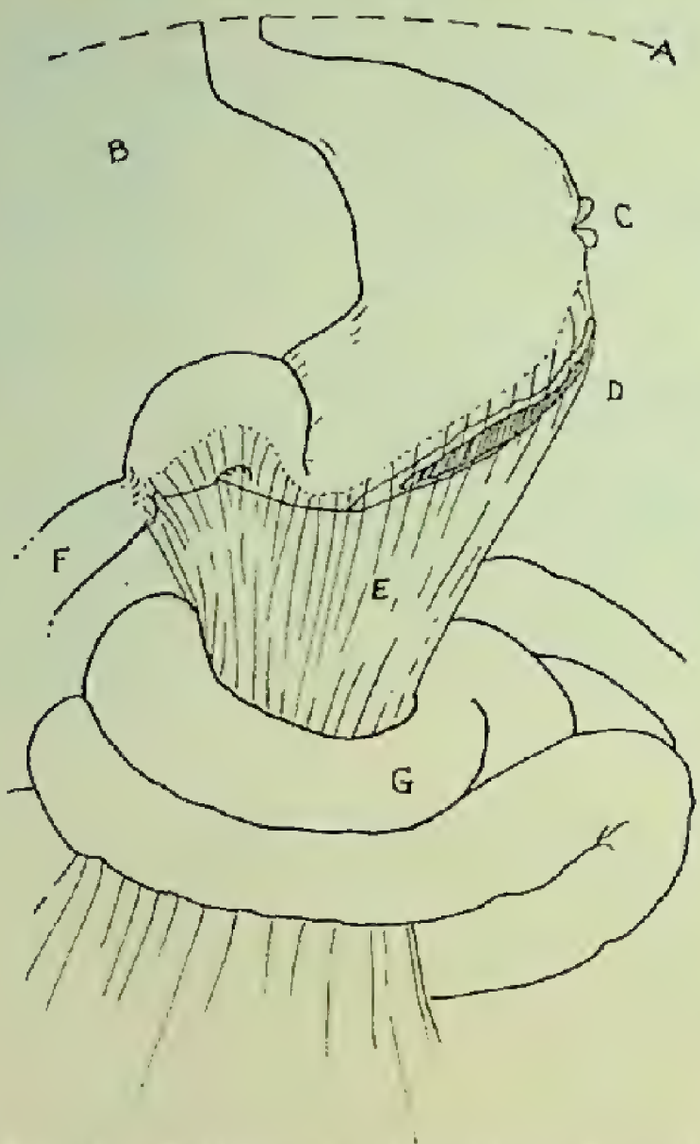


FIG. 107. Diagram of the stomach. Drawing by Edna M. Fisher.

A. Region of diaphragm.
B. Mass of liver across this area.
C. Small slit-like hole opening into the body cavity.
D. Long opening in wall of stomach, opens into great omentum.
E. Great omentum, a delicate sac of mesentery.
F. Duodenum, beginning of small intestine.
G. Coils of ileum, part of small intestine.

The nose is the most important sensory structure the sea otter possesses. It is so well equipped with muscles that it can be opened wide or closed like that of a seal. In this animal the nose was closed and stiffened in death, so only one set of measurements is possible. The nose measures 40.0 mm. (1½ in.) wide and 40.0 mm. high. The nose extends for a distance of 40.0 mm. beyond the level of the incisor teeth and even more beyond the end of the nasal bones.

The front feet or paws are also very interesting. Only the back of the paw is covered with fur, the palmar surface is naked and covered with heavy, rough black skin. The padding of the palm is highly developed, and also that of the under side of the fingers, so much so that the palm appears to be overstuffed. The fingers are not webbed but have almost lost their identity in this excessive development of the pads of the hand. The paw measures 50.0 mm. (2 in.) wide by 57.0 (2¼ in.) long. The pads extend for 10.0 mm. (⅜ in.) beyond the level of the small claws. The claws are worn quite short, hardly showing amidst the stiff hair that surrounds them. Although the paw looks awkward, the sea otter has an unusual grasping power in the small palm.

In opening the body it was found that death had evidently been due to internal bleeding and complications caused by the rupture of

the stomach wall in two places. What caused the strong walls of the stomach to give way will always be an unsolved mystery. The result of such holes was that all the food that the sea otter ate passed into the stomach and dropped immediately from the stomach through the larger hole into the cavity of the great omentum. In due time the food material became tightly packed in this sack of mesentery and the whole mass rolled around among the small intestines as the otter rolled. Such an abnormal condition permitted great quantities of foreign material, bacteria and gastric juices to come into intimate contact with the very delicate membranes that line the body cavity. It is indeed surprising that the great omentum did not rupture with such a load while the thicker and much stronger walls of the stomach gave way. Almost a half gallon of food was removed from the omental sack, but the contents have not been identified as yet. This sea otter must have been healthy to have lived as long as it did under such conditions.

The following table gives the data for two subadult males that have met their death off the Monterey coast within the last two years. The two are apparently near the same age.

Date of death	*Dec. 19, 1939 (743-EMF)*	*May 29, 1938 (84812-MVZ,UC)*
Total length	1312.5 mm.	1270.0 mm.
Tail, length	256.25	350.0
width	75.0	—
thickness	35.0	—
Hind foot, length	170.0	228.0
wide, folded	100.0	—
wide, expanded	187.5	—
Ear, to skin	25.0	26.0
to base	35.0	—
Nose, high	40.0	—
wide	40.0	—
Front foot, width	50.0	—
length	57.0	—
Weight	65 lbs.	63 lbs.

A REDESCRIPTION OF *LUVARUS IMPERIALIS* RAFINESQUE BASED UPON A SPECIMEN FROM MONTEREY, CALIFORNIA [1]

By Rolf L. Bolin
Hopkins Marine Station
Pacific Grove, California

On November 28, 1939, a specimen of the louvar, *Luvarus imperialis*, swam up on the beach at Monterey, California, Lat. 36° 36′ 08″ N., Long. 121° 53′ 18″ W., and was captured by Jack Cerrito who brought his prize to the Hopkins Marine Station. Although the species reaches a length of more than six feet, this particular specimen was small, being only about two feet in length, and was readily preserved for deposition in the Natural History Museum of Stanford University. It represents a slight northern extension in the known range of a rare but widely distributed fish which apparently has hitherto been recorded only five times from the Pacific coast of America. Two records are from Catalina Island, one from Redondo Beach, one from Point Mugu, and one from Santa Cruz Island. Since none of the western American specimens have been described and since practically all of the descriptions that do exist are to be found in comparatively old and generally inaccessible foreign publications, it seems wise to describe in detail the specimen at hand.

Measurements and Counts

Standard length 520 mm. Furcal length 572 mm. Measurements in percentage of standard length: greatest depth (midway between ventral insertion and first exposed anal ray) 34.6; distance from dorsal to anal (measured between bases of first exposed rays) 33.8; least depth of caudal peduncle 2.8; width at pectoral base 12.6; width of caudal peduncle, including keels 6.8; length of caudal peduncle 7.6; length of head 28.3; diameter of fleshy orbit 4.2; length of snout 10.0; length of upper jaw (measured to end of maxillary) 5.4; width of maxillary 2.5; distance from snout to lower end of gill opening 13.9; distance from lower end of gill opening to ventral insertion 18.4; length of gill opening 18.3; distance from snout to dorsal 58.7; length of exposed dorsal base 39.2; height of dorsal (6th ray) 10.2; distance from snout to anal 57.0; length of exposed anal base 39.2; height of anal (5th ray) 10.0; length of caudal 25.4; distance from snout to pectoral 28.9; vertical distance from dorsal body margin to pectoral insertion 20.8; vertical distance from ventral body margin to upper end of pectoral insertion 14.1; length of pectoral 26.4; width of pectoral base 5.2; distance from snout to pelvic 30.7; width of pelvic bases (both included) 1.3; length of pelvic 3.5; length of gill-rakers 1.2.

Fin formula: D. ?+XIV; A. ?+XIV; C. about 6+14+5; P. I, 18; V. I. Gill-rakers 4+11.

[1] Submitted for publication, December, 1939.

General Form

Body strongly compressed; sharply elevated anteriorly, the snout rising very abruptly in a manner reminiscent of *Coryphaena;* dorsal and ventral contours similar behind head, tapering to a slender caudal peduncle which is depressed anteriorly and almost square at its narrowest point. The peduncle bears large, fleshy, lateral keels which extend from a vertical just behind end of anal base to end of hypural.

External Body Details

Entire body covered by minute irregularly arranged scales which give the fish a frosted appearance. The individual scales are in the form of two irregular oval plates connected by a small supporting column, the whole having the form of a pair of small wheels connected by a comparatively heavy axle. Lateral line originating a little above the middle of the orbit by the union of the rather indistinct supra- and infraorbital canals. About an orbital length above and behind the



FIG. 108. *Luvarus imperialis.* Photograph by J. B. Phillips.

eye, the lateral line gives off the supratemporal canal dorsally and a little farther posteriorly the preoperculo-mandibular canal ventrally (both of these distinct), and then follows a slightly wavy course about midway between pectoral insertion and dorsal body margin anteriorly and gradually approaching the dorsal margin posteriorly until interrupted about under the fifth exposed dorsal spine. The posterior part of the lateral line originates at this vertical, slightly above the axial line (connecting the tip of the snout with the middle of the caudal peduncle), and extends to the pedunecular keel.

Head

Eye low, about on axis; small, 2.3 in snout. Nostril small, single, circular; without dermal tube or flaps; slightly anterior to rictus and slightly above level of dorsal orbital margin. Free edge of gill opening gently rounded, its curve more abrupt posteriorly; gill membranes joined to isthmus about at vertical of posterior margin of pupil, the distance from this point to tip of snout 1.3 in distance to ventral insertion; the latter distance about equal to length of gill opening. Mouth terminal, small, reaching only about 0.5 distance to vertical of orbit. Upper jaw slightly curved upward anteriorly to form a broad blunt notch from anterior view; lower jaw barely included. Maxillary very broad, about 0.5 as wide as long, sliding entirely under preorbital when mouth is closed; premaxillary forming entire border of upper jaw. A series of minute teeth along dentary; no other teeth discernible

in this individual, although they have been reported on upper jaw, palatines and tongue of other specimens. Oral valves very large and well developed; double in the upper jaw, the posterior one extending between the anterior ends of the palatines. Pseudobranchia large, well developed. Gills 4, a long slit behind the last one. Gill-rakers short, heavy, fingerlike, with a tendency to become slightly expanded distally and somewhat cupped on the inner surface, sparsely covered with minute bristles; a few minute supernumerary tubercles occur laterally between the main gill-rakers.

Fins

A striking metamorphosis is reported to occur in this species which involves marked changes in the dorsal, anal and ventral fins. The following part of the description may, therefore, not fit smaller specimens which may have the rays of these fins more numerous and longer, and the apparent origins of the median fins farther advanced. Dorsal with 14 exposed flexible, spinous rays, preceded by an undetermined number of recumbent rays hidden in a tightly closed mid-dorsal groove, which is overgrown by scales and extends forward almost to vertical of pectoral base; first exposed ray slightly anterior to end of pectoral, on a vertical about midway between anterior orbital margin and end of hypural; height of fin about equal to length of snout. Anal similar to dorsal, with 14 exposed rays and an undetermined number of recumbent ones in a mid-ventral groove which extends almost as far forward as the dorsal groove; first exposed ray a little posterior to first exposed dorsal ray; end of base slightly behind end of dorsal base; length of base of exposed fin equal to base of exposed dorsal; height of fin about equal to dorsal. Caudal broadly lunate, of 14 branched rays and about 6 dorsal and 5 ventral, simple, procurrent rays becoming deeply embedded and difficult to distinguish anteriorly. Pectoral insertion very slightly nearer to first exposed anal ray than to snout, a little below axial line; base of fin forming an angle of about 51° with axial line; axil deeply and abruptly indented to accommodate prominent muscle bundle on inner surface of pectoral base; upper ray spinous, about 0.25 as long as second; the remaining rays all branched; fin in form of an elongate trapezium, extending about to vertical of first exposed anal ray. Pelvic insertion about under base of second pectoral ray; fin reduced to a single flattened, roughly triangular spine, its length about 1.2 in orbit; the fins of the two sides closely conjoined and forming a plate over the anus, which is at the end of a short papilla arising from the bottom of an abrupt depression.

Coloration

Dorsal region blackish gray with 5 to 7 small but very distinct pink spots along base of dorsal, the spots arranged midway between the rays of the anterior part of the exposed fin; general body color silvery gray reflecting rosy tints; about 20 indistinct blackish spots scattered irregularly over the upper two-thirds of the silvery area, these spots ranging in size from about half the diameter of pupil to somewhat larger than pupil. Dorsal and anal rays pink, the membrane between them black. Caudal pink with a very distinct round blackish spot at its base which merges into the color of the peduncle anteriorly. Pectoral pink. Ventrals whitish.

EDITORIALS AND NOTES

TWENTY-FIVE YEARS AGO IN "CALIFORNIA FISH AND GAME"

The July, 1915, issue of "California Fish and Game" summarizes the fish and game laws adopted at the last session of the Legislature. Of these, one of the most important was the "districting bill" that established the various fish and game legislative districts in virtually their present form. Prior to 1915, there were only seven large districts; most of the thirty districts set up by the bill related to commercial and sport fishing. The law requiring fish dealers to render reports was also passed at that time. This law (since amplified) is the basis for California's fisheries statistical program. Several bills were passed making State waterfowl legislation correspond with the new Federal Migratory Bird Law, and an end was put to the practice of "bull hunting" or the use of an animal for a blind in waterfowl shooting.

W. P. Taylor, in an editorial, described the two kinds of conservationists that existed and still exist—the apathetic and the active. He calls them the conservationist of the folded hands and the conservationist of the clenched fist, and goes on to say, "There is much to be done, and it will not be done by the conservationist of the folded hands!" What he says is to the point. It is not the apathetic one who builds up our game and fish, our forests and other natural resources. Only the person who takes an active part in conservation work can stop the forces of special interest from wiping out our wildlife. This message can not be repeated too often—lend a hand, the clenched fist kind of hand, to the cause of conservation!—*Richard S. Croker, Editor, California Fish and Game.*

HIGH POWERED ENGINES FOR CENTRAL CALIFORNIA JIG BOATS

Within the past year, a noticeable number of San Francisco and Monterey market fishermen, owning jig boats, have been replacing slow, heavy duty, one- and two-cylinder gasoline engines with modern, high-powered, multiple-cylinder gasoline engines. The main reasons for this change are a desire for more speed to make distant fishing grounds accessible, and also for a quieter, smoother running engine at trolling speeds which should result in better catches of albacore and salmon. Not only will distant grounds be made more available but the fishermen can spend more time in actual fishing on the nearby grounds.

The market jig boats at San Francisco and Monterey involved in this speed-up are 20 to 35 feet in length. The engines being replaced are one- and two-cylinder gasoline engines of 6 to 16 horsepower. A few are diesels. These engines push the boats at five or six knots.

The new engines are 40- to 85-horsepower gasoline motors converted for marine use. These are mostly of 6 cylinders but a few are of

4 cylinders. The prices range from $225 to $750, depending on the horsepower, plus about $100 for installation. Where the proper propellor is used, the engines have increased the speed of boats 50 per cent or more. Some boats that formerly made 6 knots are now capable of 10. In a specially designed hull, the speed possibilities are even greater, as shown by the experience of several fishermen who have had new boats built and powered with high-speed engines. Some of these boats are said to make 14 to 18 knots.

Light, high-powered diesel engines are also available, but these are priced about four times as much as the gas engines of similar horsepower. If these were within the price range of the gasoline engines, no doubt there would be many diesel installations as the latter type is safer and cheaper to operate.

High-powered, high-speed gasoline engines are not new among the hook and line boats. During previous years, an occasional fisherman has installed a 4- or 6-cylinder engine from an automobile in his boat. However, these were usually motors from cars that had already seen a great deal of road service, and the installations were makeshift so that they did not prove altogether satisfactory.

To date, about one-tenth of the jig boats at San Francisco and Monterey, or approximately 70 boats, have been converted by installations of high-powered, high-speed gasoline engines. It may take several years for the majority of these fishermen to make the change, with the financial status of the fisherman as an important factor, but the trend is well under way in the Central California region.—*J. B. Phillips, California State Fisheries Laboratory, Division of Fish and Game, May 25, 1940.*

A "SELF CANNED" SHARK

One of the most unusual of incidents that might occur to a fish was observed recently at the San Francisco wholesale fish markets.

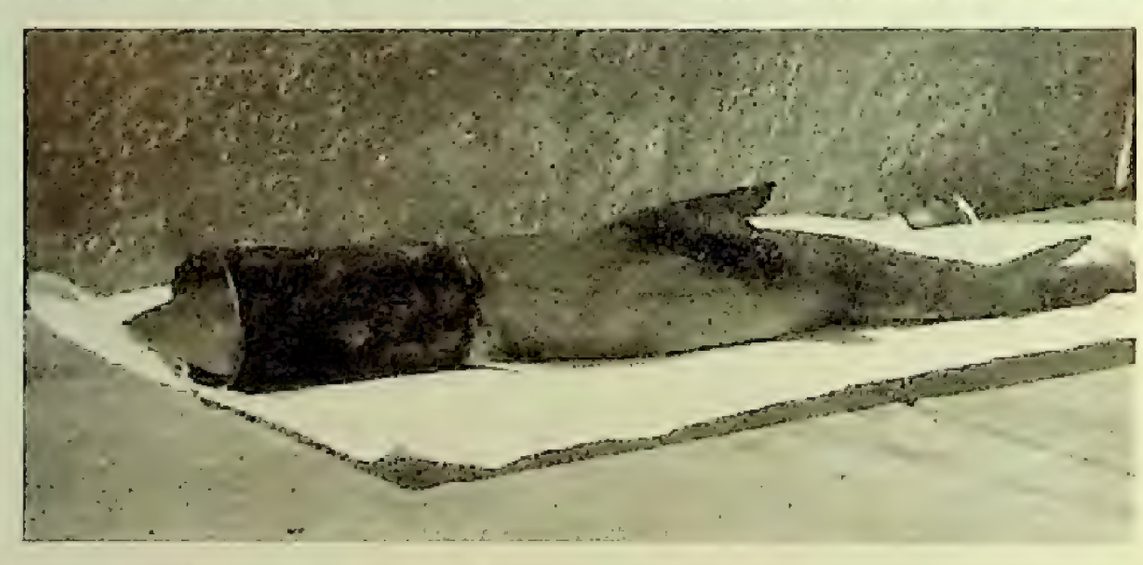


Fig. 109. Smooth-hound shark with its head encased in a tin can.

A 32½-inch gray smooth-hound shark (*Mustelus californicus*) caught by a trawler and delivered to the International Fisheries Company on February 14, 1940, was observed to have its head firmly encased in a one-pound tin can. Both ends of the can were missing, and two

inches of the shark's snout projected, permitting it to see and no doubt to feed in a small way.

Just how the shark became "canned" is not difficult to imagine. It evidently thrust its snout into the can as it was snooping about on the ocean floor and did not have sense enough to stop or back up upon feeling itself encased therein. It perhaps tried stubbornly to force its way through, which resulted in fastening the can more firmly on its head. The inner surface of the can which had been in close contact with the head had been worn very smooth. Upon removing the can, a broad, shallow groove was seen encircling the head where the can had been held fast. The portion of the head that had been covered was a shade darker than the uncovered sections.—*L. E. Herz, San Francisco State College, February 24, 1940.*

BROWN RAGFISH TAKEN AT MONTEREY

While fishing from the Monterey breakwater on May 20, 1940, Mr. L. A. Yeeny of Salinas, California, caught a large fish which was entirely unknown to the local commercial fishermen. It proved to be the third specimen of the brown ragfish (*Acrotus willoughbyi*) which has been reported from California. This rare visitor, which on the basis of the meager available records appears to be taken about once every 20 years from the waters of the state, is stated by Schultz and DeLacey (1936) to be not rare in the Pacific Northwest, although I have been able to find only eleven definite records of its previous capture.



FIG. 110. The Monterey specimen of the brown ragfish, *Acrotus willoughbyi*, and its captors, L. A. Yeeny and family. May 20, 1940.

Acrotus willoughbyi was originally described by T. H. Bean (1887) from a specimen cast upon shore at Damon, Washington, in 1887. Jordan and Evermann (1896-1898), without giving any of the circumstances of capture and without adding any details to the type description, mention two additional individuals, one taken at Port Townsend, Washington, and the other at Monterey, California. It was probably the first of these specimens that provided the data for the measurements and notes presented by B. A. Bean (1898). Twenty years later Kincaid (1919) reported that the species was a rare straggler into Puget Sound and that it had been taken as far from the open ocean as Tacoma. The next specimen turned up in California and was reported by Higgins (1921) as being taken in a mackerel net off San Pedro. Crawford (1927) listed the species as having been taken in 1925 at Gig Harbor and Whidby Island, both in Puget Sound, while Schultz and DeLacey (1936) added the San Juan Islands and Petersburg, Alaska, to the known localities. The

latest records are those of Cowan (1938) who reported one specimen captured in 1935 from the breakwater at Vancouver, B. C., and another in 1936 in fish traps at Sooke on the southern end of Vancouver Island.

The fish captured at Monterey agreed moderately well in all essential details with the type description and with the additional notes and measurements given by B. A. Bean (1898). However, as so little has been added to our knowledge of this interesting fish since its discovery more than half a century ago, I consider it advisable to present a list of proportional measurements and counts based on the recently captured specimen, together with comparative data calculated from the published descriptions of the two other specimens which have been measured. The data presented are far from satisfactory but they do give some idea of the magnitude of proportional variation within the species.

COUNTS AND MEASUREMENTS (IN PERCENTAGE OF STANDARD LENGTH) OF *ACROTUS WILLOUGHBYI*

	Damon specimen (type)	Port Townsend specimen	Monterey specimen
Standard length	"nearly six feet"	55¾ inches	152 cm. (59¾ inches)
Greatest depth	30.0	26.9	----
Depth at dorsal origin	----	----	22.0
Depth of caudal peduncle	----	5.1	5.8
Length of head	16.7	14.4	14.7
Diameter of eye	1.4	[a]2.2	[b]1.4
Length of snout	4.2	----	5.5
Length of upper jaw	5.6	----	6.0
Snout to dorsal origin	----	[a]32.3	37.2
Length of dorsal base	----	[a]52.0	47.1
Height of dorsal	5.6	3.1	4.1
Snout to anal origin	52.0	44.9	47.4
Length of anal base	----	37.7	36.5
Height of anal	5.6	3.1	4.1
Snout to pectoral insertion	----	16.1	15.7
Width of pectoral base	----	3.8	3.2
Longest pectoral ray	11.1	13.0	12.7
Middle caudal ray	11.1	7.6	6.9
Dorsal rays	41	38 or 40	42
Anal rays	36	34 or 35	38
Pectoral rays	20	21	18
Gill rakers	6+9	7 to 10	6+9

[a] Accuracy questioned by B. A. Bean himself.
[b] Membranous orbit.

References

Bean, Barton A.

1898. Notes on the capture of rare fishes. U. S. National Museum. Proceedings, vol. 21, pp. 639-640.

Bean, Tarleton H.

1887. Description of a new genus and species of fish, *Acrotus willoughbyi*, from Washington territory. *Ibid.*, vol. 10, pp. 631-632.

Cowan, Ian McTaggart.

1938. Some fish records from the coast of British Columbia. Copeia, 1938, no. 2, p. 97.

Crawford, D. R.

1927. Records of rare fishes from the north Pacific during 1925. Copeia, no. 168, pp. 182-184.

Higgins, E.

1921. A strange rag fish at San Pedro. California Fish and Game, vol. 7, p. 179.

Jordan, D. S., and Evermann, B. W.
1896-1898. The fishes of North and Middle America. U. S. National Museum, Bulletin, no. 47, pp. 973, 2849.

Kincaid, Trevor.
1919. An annotated list of Puget Sound fishes. Olympia, Washington, F. M. Lamborn. 51 pp.

Schultz, L. P., and DeLacy, A. C.
1936. Fishes of the American Northwest. Part 2. Mid-Pacific Magazine, Jan.-Mar., 1936, pp. 63-78.

—Rolf L. Bolin, Hopkins Marine Station, May, 1940.

A CALIFORNIA NEEDLEFISH RECORDED AT MONTEREY

A California needlefish (*Strongylura exilis*) was taken a short distance off Monterey on May 13, 1940. The specimen appeared in a bait catch made by a crew of market fishermen using a lampara net. This species has previously been noted as occurring only as far north as Point Conception and from this point southward to Cerros Island, on the coast of Lower California. The present record extends the range some 150 miles to the northward. This specimen was small, measuring eleven inches, total length, as compared to adults attaining a length of three feet.—*J. B. Phillips, California State Fisheries Laboratory, Division of Fish and Game, May 25, 1940.*

REVIEWS

The Fishes of the Family Sciaenidae (Croakers) of California.

By Tage Skogsberg. California Division of Fish and Game. Fish Bulletin, No. 54, 62 pp., 16 figs., 1939.

The author, Dr. Skogsberg, was at one time on the staff of the California State Fisheries Laboratory of the Division of Fish and Game, but in recent years has been a member of the faculty at the Hopkins Marine Station of Stanford University.

As the title of this new State publication indicates, only those species of the family that occur in California are treated. The family Sciaenidae is a large one composed of many genera occurring in the warm seas, but only a few species extend into moderately cool waters. Nine species are found in California waters, the most important of which is the white sea-bass. This species is not only a desirable sport fish but also is of considerable importance in the commercial catch delivered to fresh fish markets. The California corbina, spotfin croaker and yellowfin croaker are highly prized by surf fishermen along the southern beaches of the State, and the short-fin sea-bass and black croaker enter the sport catch in lesser amounts. Thompson's croaker is so rare that it interests only the collector of fishes. The two remaining species, kingfish and queenfish, are caught in small quantities commercially but are looked down upon by ocean anglers. Two other croakers, the totuava and Gulf corbina of Mexico, are discussed briefly by the author as they are brought into this State by truck and sold extensively in our fish markets.

Dr. Skogsberg has prepared a standardized form of detailed description based upon several rather than a few specimens, followed by notes on occurrence of each species, food, spawning, and the sport and commercial importance. Photographs and drawings illustrate the bulletin. It is the author's hope that this report may serve as a form to be followed by similar reviews of other families of our fishes, so that eventually the separate bulletins may be combined into a handbook.—*W. L. Scofield, Supervisor, California State Fisheries Laboratory, Division of Fish and Game.*

Report on Returns of Drift Bottles Released off Southern California, 1937.

By Richard B. Tibby (former member of the California State Fisheries Laboratory). California Division of Fish and Game. Fish Bulletin, No. 55, 36 pp., 22 figs., 1939.

In 1937 very little was known of the local currents near the southern California coast. Peculiarities in the occurrence of both eggs and larvae of the sardine suggested that the general set of surface currents in the area of maximum sardine spawning during the spring and summer would furnish the explanation of egg and larval distribution. It

was decided, therefore, that the California State Fisheries Laboratory of the Division of Fish and Game would attempt a rough determination of these surface currents by releasing serially numbered drift bottles, each containing a postpaid card to be filled out and mailed by the finder of a bottle. It was recognized that the percentage of returns would be low because a southward drift, as was suspected, would carry the bottles onto the almost uninhabited beaches of Lower California.

In planning this experiment we found the experienced advice of Dr. H. U. Sverdrup, Director of the Scripps Institution of Oceanography, to be most valuable, and during the discussions there was evolved a cooperative plan by which the Division of Fish and Game, while releasing the bottles, would assist the personnel of the Scripps Institution in taking water samples for a more detailed picture of water movements by dynamic methods. At that time, the Scripps Institution staff was handicapped by the loss of their research vessel, since replaced. This cooperative plan proved to be more that satisfactory and resulted in a more complete determination of currents than possibly could have been had by drift bottles alone. Drift bottle returns indicated only roughly the general currents, but they proved to be of most value in checking dynamic determinations made by the Scripps Institution of Oceanography.

In the spring and summer of 1937, three trips were made by the Division's patrol boat *Bluefin* for the release of bottles and the taking of water samples. Each trip covered four station lines run through the area from Point Conception to the Mexican boundary and from shore out to distances varying from 135 to 180 miles. Approximately 6,000 bottles were released and 185 or 3.2 per cent were recovered, a return considerably greater than we had expected.

Possibly of most interest to the general reader will be Tibby's discussion of the relationship between local surface currents and the survival of sardine eggs and larvae. Sardine larvae and very young fish, resulting from a spawning inside the California Current, are apt to be carried southward to nursery grounds along the coast of southern and Lower California, but larvae from spawnings in the California Current itself may be swept offshore and possibly lost. It is suggested that the yearly variations in this current may have a profound influence upon the survival of sardine spawn and may be an important cause of the variations in abundance of incoming year-classes.—*W. L. Scofield, Supervisor, California State Fisheries Laboratory, Division of Fish and Game.*

In Memoriam

JAMES H. VOGT

The Division of Fish and Game lost one of its most valued employees by the death of James H. Vogt in Sacramento on April 20, 1940. Mr. Vogt had been absent on sick leave from his position as Assistant Chief of the Bureau of Fish Conservation since August, 1939. In recent months his convalescence had been very encouraging and it had been hoped that he would eventually be able to resume his duties. Mr. Vogt was deeply interested in his work and during his illness frequently expressed his hopes that he would again be able to return to active duty. Unfortunately, that desire could not be realized. Mr. Vogt was employed by the California Division in 1927, after many years of being in charge of the Nevada State Fish Hatchery at Verdi. Following a few months of construction work, he was assigned as foreman of the new experimental hatchery near Kernville. In December of 1928, he was transferred to the San Francisco office in an administrative position. His outstanding ability and knowledge of fish culture led to his appointment as Assistant Chief of the Bureau of Fish Culture in 1929, which position he held until his death. His career during this period was one of outstanding service to the Division of Fish and Game, and can be briefly characterized as being high in the standards he set both for himself and for others, his impartiality in dealing with employees and his pride in seeing work well done.

The death of James H. Vogt is a serious loss to the Division as an organization, and personally to his many friends within and without the State service.—*A. C. Taft, Chief, Bureau of Fish Conservation, Division of Fish and Game.*

REPORTS

STATEMENT OF REVENUE

For the Period July 1, 1939, to March 31, 1940, of the Ninety-first Fiscal Year

Revenue for Fish and Game Preservation Fund:

License Revenue—

1940 Series:		
Angling	$47,404 00	
Fish tags	772 50	
Game tags	105 75	
Market fishermen	1,310 00	
Fish importers	75 00	
Fishing party boat permits	147 00	
Fish breeders	415 00	
Game breeders	1,107 50	
Kelp licenses	10 00	
Total, 1940 series		$51,346 75
1939 Series:		
Angling	$442,926 50	
Hunting	506,864 50	
Commercial hunting club	850 00	
Commercial hunting club operator	320 00	
Deer tags	150,211 00	
Fish breeders	45 00	
Fish importers	10 00	
Fish packers and wholesale shell fish dealers	1,075 00	
Fishing party boat permits	193 00	
Fish tags	1,851 48	
Game breeders	160 00	
Game tags	465 54	
Market fishermen	42,310 00	
Trapping	1,897 00	
Total, 1939 series		$1,149,179 02
1938 Series:		
Angling	$7,854 51	
Deer tags	2,653 00	
Hunting	17,796 00	
Market fishermen	2,400 00	
Trapping	145 00	
Total, 1938 series		$30,848 51
1937 Series:		
Angling	$115,265 03	
Commercial hunting club	50 00	
Commercial hunting club operator	10 00	
Deer tags	11,437 00	
Fish breeders	15 00	
Game breeders	5 00	
Hunting	43,811 47	
Market fishermen	180 00	
Trapping	341 00	
Total, 1937 series		$171,114 50
1932, hunting	$87 35	
1928, angling	645 68	
1928, deer tags	10 00	
1928, hunting	2,971 00	
Total, 1932 and 1928 series		$3,714 03
Total licenses, 91st fiscal year		$1,406,202 81

Other Revenue:		
Court fines	$30,117 88	
Deer meat permits	900 00	
Fish packers	324,892 30	
Kelp tax	241 86	
Leases game refuges	583 80	
Lease of kelp beds	52 80	
Miscellaneous revenue	8,312 92	
Publication sales	259 71	
Salmon tax	15,349 57	
Total other revenue		$386,710 84
Prior year (90th fiscal year)—		
1938 Series:		
Angling	—$6 00	
Fish packers and wholesale shell fish dealers	35 00	
Fish importers	—5 00	
Hunting	35 50	
Trapping	—2 00	
Total, 90th prior year, 1938 series		$57 50
1937 Series:		
Hunting	—$35 00	
Trapping	1 00	
Fish packers and wholesale shell fish dealers	—30 00	
Total, 90th prior year, 1937 series		—$64 00
Prior year (89th fiscal year)—		
1938 Series:		
Angling	$120 00	
Fish importers	5 00	
Fish packers and wholesale shell fish dealers	—5 00	
Fish tags	—1,767 24	
Game tags	—161 34	
Hunting	—36 00	
Market fisherman	420 00	
Total, 89th prior year, 1938 series		—$1,424 58
1937 Series:		
Angling	—$141 00	
Deer tags	—3 00	
Fish tags	1,767 24	
Game tags	161 34	
Hunting	1 00	
Market fisherman	—420 00	
Trapping	—2 00	
Total, 89th prior year, 1937 series		$1,363 58
Grand total—all years, Fish and Game Preservation Fund		$1,792,846 15

STATEMENT OF EXPENDITURES

For the Period July 1, 1939, to March 31, 1940, of the Ninety-first Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Administration—					
Cashier	$1,470 00				$1,470 00
Executive	3,749 94	$212 06	$3,738 31	$66 07	7,766 41
Exhibits			1,250 00		1,250 00
General office	6,007 69	5,276 77	31,497 90	142 40	42,924 76
Library	1,523 02	34 25	136 57	161 02	1,854 86
Property inspection	2,445 00	125 83	138 38	25 46	2,734 67
Publicity			1,222 19		1,222 19
Total Administration	$15,195 65	$5,648 91	$37,983 35	$394 95	$59,222 89
Patrol and Law Enforcement—					
Cannery inspection	$24,970 93	$522 59	$2,241 03		$27,734 55
Executive	12,105 00	349 08	1,359 28	$532 81	14,406 17
General office	4,600 81	764 25	328 86	134 66	5,828 58
Junior patrol	3,513 44	577 22	1,181 54	3 42	5,275 62
Land patrol	167,161 12	28,628 27	47,147 50	13,935 65	256,872 54
Marine patrol	63,105 95	17,135 05	15,300 98	10,042 22	135,897 20
M. V. Bluefin Galley		450 64			450 64
M. V. —N. B. Scofield Galley		—227 09			—227 09
Pollution patrol	9,322 91	2,003 99	3,081 49	1,376 85	15,785 24
Total Patrol and Law Enforcement	$284,840 16	$50,507 00	$100,640 68	$26,025 61	$462,013 45
Marine Fisheries—					
Central Valley Water Project Study	$5,279 89	$882 87	$2,516 60	$4 36	$8,683 72
Executive	4,510 00	177 73	273 59		4,961 32
Field supervision	2,610 00	228 25	771 21		3,609 46
Fish cannery auditing			3,003 49		3,003 49
General office	8,986 92	502 24	763 57	3 10	10,255 83
Research and statistics	40,092 58	3,261 66	8,131 26	1,994 47	53,482 97
Total Marine Fisheries	$61,479 39	$5,052 75	$15,522 72	$2,001 93	$84,056 79
Fish Conservation—					
Biological survey	$9,269 00	$766 54	$985 96	$612 55	$11,614 05
Executive	5,305 24	153 89	253 63		5,712 76
Field supervision	3,675 00	418 38	765 07		4,858 45
Fish food unallocated		6,495 81	2,399 51		8,895 32
Fish planting	1,913 25	558 73	1,135 20	1,212 24	4,819 42
Fish rescue	7,692 77	965 17	1,821 99		10,479 93
General office	3,905 12	601 89	146 71	52 21	4,705 93
Pollution inspection	3,849 00	351 35	711 13	139 43	5,050 91
Statistical	1,845 00	315 08	1,741 65		3,901 73
Structural maintenance	3,390 00	393 52	1,267 96	28 33	5,079 81
Alpine Hatchery	1,052 74	495 67	124 94		1,673 35
Basin Creek Hatchery	3,257 91	415 26	177 68		3,850 85
Benbow Dam Experimental Station	2,541 12	138 53	125 58	4 88	2,810 11
Big Creek Hatchery	1,795 00	331 22	237 46	9 44	2,373 12
Blue Lakes Egg Collecting Station	405 40	7 63	27 36		443 39
Bogus Creek Egg Collecting Station	750 00	81 22	96 00		930 22
Brookdale Hatchery	2,680 93	321 67	191 67	2 17	3,196 44
Burney Creek Hatchery	4,552 29	619 06	182 51	6 15	5,360 01
Central Valleys Hatchery	2,282 50	964 48	1,132 99	220 69	4,600 66
Cold Creek Hatchery			10 00		10 00
Copco Egg Collecting Station		30 48	85 64	9 84	125 96
Cottonwood Lakes Egg Collecting Station			4 00		4 00
Experimental Hatchery	1,386 45	106 31	28 87		1,521 63
Fall Creek Hatchery	5,290 53	1,287 70	235 71	709 54	7,523 48
Feather River Hatchery	3,885 07	869 99	514 16		5,269 22
Fern Creek Hatchery	931 46	175 84	299 04		1,406 34
Forest Home Hatchery	3,665 33	2,808 65	761 26	1,106 42	8,341 66
Fort Seward Hatchery	2,877 61	365 94	46 54	8 68	3,298 77
Heenan Lake Egg Collecting Station		110 97	1 21	30 08	142 26
Hot Creek Hatchery	3,525 93	3,743 46	626 26	191 70	8,090 35
Huntington Lake Hatchery	1,466 78	551 15	317 70		2,335 63
June Lake Egg Collecting Station			16 30		16 30
Kaweah Hatchery	3,411 75	1,055 77	735 30	24 81	5,227 66
King Salmon Experimental Station			11 08		11 08
Kings River Hatchery	3,674 50	2,528 71	399 90	518 41	7,121 52
Kirman Lake Egg Collecting Station	283 75	6 62			290 37
Klamathon Egg Collecting Station	1,497 13	125 82	48 15	90 13	1,761 23
Lake Almanor Hatchery	4,603 55	1,275 44	252 82	8 86	6,140 67
Lake Eleanor Egg Collecting Station	46 13	18 60			64 73
Little River Egg Collecting Station	360 00	21 90	12 00		394 50

STATEMENT OF EXPENDITURES

For the Period July 1, 1939, to March 31, 1940, of the Ninety-first Fiscal Year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Fish Conservation—Continued					
Little Walker Lake Egg Collecting Station	$252 27	$9 82			$262 09
Lytle Creek Hatchery	12 25	5 70	$28 30		46 25
Mad River Egg Collecting Station	560 00	48 22	11 00		619 22
Madera Hatchery	1,021 94	695 69	310 72		2,028 35
Marlette Lake Egg Collecting Station	360 00	89			360 89
Mount Shasta Hatchery	29,978 90	8,152 74	1,970 87	$477 46	40,579 97
Mount Tallac Hatchery	2,099 40	1,820 59	181 27	8 85	4,110 11
Mount Whitney Hatchery	10,118 74	1,788 46	1,719 57	798 01	14,424 78
Mountain Home Hatchery	3,960 00	2,266 72	1,122 21		7,348 93
Prairie Creek Hatchery	4,169 65	920 15	473 15	20 63	5,583 58
Rush Creek Egg Collecting Station	640 00	9 54	18 48		668 02
San Lorenzo Egg Collecting Station		56 36	1 00		57 36
Scott Creek Egg Collecting Station	1,305 00	100 11	47 69	3 10	1,455 90
Shackleford Creek Egg Collecting Station	140 00		50 00		190 00
Shasta River Egg Collecting Station	870 20	69 21	10 50		949 91
Snow Mountain Egg Collecting Station	1,125 81	77 74	32 58		1,236 13
Tahoe Hatchery	4,745 17	1,210 31	380 32		6,335 80
Upper Truckee Egg Collecting Station	31 93		10 00		41 93
Waddell Creek Station	840 00	37 28	27 94	2 73	907 95
Yosemite Hatchery	3,523 72	710 31	202 70		4,442 73
Yuba River Hatchery	2,789 19	509 62	130 49	6 74	3,436 04
Total Fish Conservation	$165,684 41	$47,970 91	$24,640 33	$6,298 11	$244,599 76
Hydraulics—					
Engineering	$6,259 85	$834 97	$1,523 85	$13 91	$8,632 58
Executive	3,240 00	227 48	522 07		3,989 55
General office	1,085 00	33 06	178 69	100 50	1,397 25
Total Hydraulics	$10,584 85	$1,095 51	$2,224 61	$114 41	$14,019 38
Game Conservation—					
Deer damage control	$281 86	$136 63	$181 84		$600 33
Duck rescue	739 82	294 67	644 26	$337 10	2,015 85
Elk refuge	1,350 00	392 98	269 35		2,012 33
Executive	6,775 32	699 69	1,449 55	459 77	9,384 33
Game management	6,139 68	1,320 19	1,085 04	708 16	9,253 07
General office	2,430 00	152 74	11 78	53 80	2,648 32
Grey Lodge Refuge	3,670 00	703 20	80 07	1,125 22	5,578 58
Imperial Refuge	1,812 11	159 12	89 67	123 05	2,183 95
Los Banos Refuge	3,551 61	679 08	470 26	569 55	5,270 50
Predatory animal—lion hunting	4,655 00	770 11	5,111 30	1,416 32	11,952 73
Predatory animal—trapping	22,004 02	4,189 87	4,077 89	63 74	30,335 52
Refuge posting		345 57			345 57
Research	5,900 34	1,405 15	2,431 65	1,344 91	11,082 05
Statistics	1,800 00	97 57	972 22		2,869 79
Suisun Refuge	3,070 88	392 03	367 40	683 10	4,513 41
Winter feeding and salting of game		318 56			318 56
Total Game Conservation	$64,180 64	$12,057 25	$17,242 28	$6,884 72	$100,364 89
Game Farms—					
Executive	$2,610 00	$95 58	$785 25		$3,490 83
Game bird distribution—					
Los Serranos		390 87	50 71		441 58
Yountville	4,140 69	2,161 26	1,101 22	$561 35	7,964 52
General office	814 03			15 45	829 48
Los Serranos Boarding House			77 58		77 58
Los Serranos Game Farm	8,907 30	2,129 01	1,135 71	92 68	12,264 70
Yountville Boarding House	254 35	490 93	132 15		877 43
Yountville Game Farm	8,384 66	2,866 35	1,186 74	706 60	13,144 35
Total Game Farms	$25,111 03	$8,134 00	$4,469 36	$1,376 08	$39,090 47
Licenses—					
Executive	$2,745 00	$174 84	$239 60		$3,159 44
General office	720 00	346 88	94 49	$513 60	1,674 97
License distribution	9,978 77	10,000 48	56,026 67		76,005 92
Total Licenses	$13,443 77	$10,522 20	$56,360 76	$513 60	$80,840 33
Other Current Expenses—					
Maintenance and construction of fish screens					
Other stream improvements—					
Fish screens—all objects					$20,583 24

STATEMENT OF EXPENDITURES

For the Period July 1, 1939, to March 31, 1940, of the Ninety-first Fiscal Year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Stream Improvements—					
American Lake check dam		$84 72			$84 72
American River Improvement Project		18 80			18 80
Granlees Dam Fishway Project	$1,173 32	1,076 41	$114 85	$2 46	2,367 04
Overhead		17 10	10 50	749 71	777 31
Removal of riffles on Lower Eel River			96 00		96 00
Sheep Camp Lake Project			20 00		20 00
Total Stream Improvements					$3,363 87
Total Other Current Expenses					$32,947 11
Total from Support, 91st fiscal year					$1,117,155 07
Special Item—					
Appropriation to pay claim of Department Accounting Officer, Department of Finance, 91st fiscal year, Ch. 1016-39					$393 61
Total Operating Expenditures, 91st fiscal year					$1,117,548 68
Contributions to Employees' Retirement System, 91st fiscal year					$18,881 79
Expenditures for Additions and Betterments—					
Purchases for game refuges and public shooting grounds and construction, improvement and equipment—all projects—					
Improvements	$1,572 19	$1,240 28	$605 30	$2,172 88	$5,590 65
Total 91st fiscal year					$1,145,030 12
Prior Bienniums—					
Prior year 90th for support not closed					$1,865 54
Prior year 89th for support not closed					—517 20
Prior year 88th for support not closed					1 13
Total for Prior Bienniums					$1,349 47
Grand total Fish and Game					$1,146,379 59

GAME CASES

January, February and March, 1940

Offense	Number arrests	Fines imposed	Jail sentences (days)
Bear: Killing in closed season	2	$50 00	
Black Brant: Closed season	1		10
Coots: Hunting, no license; closed season	7	55 00	10
Cottontails: Closed season	5	75 00	12½
Deer: Killing spike buck, female deer; taking by spotlight; failure to tag deer; killing doe; night hunting; possession spike buck; killing forked horn deer in Dist. 12¼; fail to validate deer tag; possession venison closed season	101	3,400 50	1,923½
Doves: Closed season, no license	6	105 00	
Ducks: Shooting from motor vehicle; no license; closed season; take before 7 a.m.; overlimit	41	1,982 50	115
Elk Hide: Unlawful possession	1	10 00	
Game Birds: No license	1	5 00	
Game Refuge: Shooting into; hunting in; possession gun in game refuge	10	142 50	5
Geese: Killing; closed season; illegally possess wild goose	8	155 00	1
Grebe: Killing	1		
Grouse: Possession of	1	25 00	
Hunting: No license; nongame birds at night; with spotlight; refuse to show license on demand; fail to show hunting license	39	786 00	27
Killdeer: Killing	1	10 00	
Larks: No license; shoot from auto	2	50 00	
Mudhens: Closed season	1	10 00	
Non-Game Birds: Killing, no license	7	145 00	12½
Partridge: Kill chukar; unlawful sale	2	5 00	
Pheasant: Possession more than ten days after closed season; no license; operating pheasant snares; closed season	12	380 00	25
Quail: Closed season; possess desert quail, closed season	7	85 00	25
Rabbits: No license	3	30 00	
Robbing traps of a licensed trapper	4	65 00	
Robin: Possession	3	100 00	
Sagehen: Possession parts of	1	25 00	
Sea Otter: Possess skin	1	50 00	
Shooting: From a public road; before 7 a.m., closed season; from an auto	10	172 50	7½
Shorebirds: Taking protected shorebirds	3	50 00	
Spotlight: Possession ½ hour after sunset and ½ hour before sunrise; unlawful use of	6	200 00	40
Squirrel: Taking tree squirrel	1	25 00	
Swan: Possession	2	25 00	15
Trapping: Taking bird with trap; trapping in a refuge; trapping, no license	5	85 00	12
Waterfowl: Hunting at night	4	75 00	12½
Totals	303	$8,388 00	2,253½

FISH CASES

January, February, March, 1940

Offense	Number Arrests	Fines imposed	Jail sentences (days)
Abalone: Possession undersized; no license; closed season; overlimit	29	$570 00	130
Angling: No license; alien with citizen's license; night; with 2 poles; closed season; using another's license; fail to show on demand	39	507 00	122½
Bass: Striped; overlimit; more than 1 pole; angling with 2 lures; night fishing for striped bass; black bass; closed season	43	640 00	80
Bluegill: Overlimit; closed season; no license	11	125 00	62½
Clams: Possession; night; undersized; overlimit; Pismo; possess clams in clam preserve; cockle clams; no license	37	533 00	393½
Cockles: Taking undersized, no license; overlimit	3	85 00	
Commercial Fishing: No license; sell fish no license; fail to keep records	38	620 00	
Crabs: Undersized	10	110 00	
Crappie: Closed season	1	15 00	
Cutting a net being legally used	2	250 00	
Fail to keep record of fish sales, to show fish on demand and to maintain and operate a fishway	3	10 00	
Gaff: Take salmon; possession within 300 feet of stream; take steelhead; possession by Santa Ynez River, take trout with gaff; at night	17	425 00	25
Gill Net: Operating set net in Dist. 16 possession	4		75
Lobsters: Possession short lobsters	9	230 00	60
Mullet: Taking and selling, no commercial license	2		15
Operating nets with meshes measuring less than 2½ inches	4		
Operating fish trap	1	25 00	
Pitchfork: Possession, take salmon, take steelhead, by Santa Ynez River	9	215 00	
Pollution	19	3,175 00	
Purse Seine Net: Use to take fish	1	350 00	
Reducing whole fish except as provided by Fish and Game Code; using whole fish in a reduction plant	2	200 00	
Refusing to deliver fish receipts	1	25 00	
Salmon: Closed district; use firearm and artificial light to take salmon; shoot with a rifle	7	70 00	10
Sardines: Selling, no commercial license	4	70 00	
Set Lines: Closed district; in District 12-C	6	325 00	
Shrimps: Retaining fish other than shrimp in shrimp trawl	1	135 00	
Spear: Possess within 300 feet of a stream; possess on stream closed to spearing; closed stream	15	890 00	
Steelhead: Spearing; closed district; take with gaff; take with spear; snagging; take other than by angling; take with shovel in closed district	21	428 00	31
Trout: Take other than by angling; snagging; closed season	12	235 00	
Totals	351	$10,263 00	1,001½

SEIZURES OF FISH AND GAME

January, February, March, 1940

Fish:	
Abalone	474
Bass, black, lbs.	31½
Bass, striped, lbs.	1,103
Bluegill	136
Catfish, lbs.	760
Clams	887
Cockles	385
Cod, lbs.	40
Crappie	1
Lobsters	285
Lobsters, lbs.	103
Lobster traps	23
Rainbow trout	174
Spear	1
Steelhead trout, lbs.	05½
Steelhead trout	4
Game:	
Coot	3
Deer	4
Deer meat, lbs.	1,518½
Doves	13
Dowitchers	10
Ducks	303
Geese	6
Killdeer	7
Partridges, chukar	7
Pheasants	14
Quail	12
Rabbits, brush	2
Robins	14
Sea otter skin	1
Sparrows, white-crowned	2
Squirrel	1
Swan	2

SHIPMENTS OF FRESH FISH FROM OTHER STATES AND FOREIGN COUNTRIES

January, 1940

	South of international boundary	Japan
For fresh fish markets:*		
Cabrilla	260	
Corbina, Mexican	1,275	
Sea-bass, Black	108	
Sea-bass, Totuava	180,301	
Total pounds	181,950	

February, 1940

	South of international boundary	Japan
For fresh fish markets:*		
Barracuda	447	
Corbina, Mexican	3,940	
Sea-bass, Black	203	
Sea-bass, Totuava	174,263	
Crustacean:		
Shrimp	2,670	
Total pounds	181,523	

March, 1940

	South of international boundary	Japan
For canneries:		
Tuna, Skipjack		57,590
For fresh fish markets:*		
Barracuda	761	
Cabrilla	38	
Corbina, Mexican	13,536	
Sea-bass, Short-fin	2,188	
Sea-bass, Totuava	170,458	
Total pounds	186,981	57,590

* This record includes only that fish which is voluntarily reported to the Division of Fish and Game and does not represent all shipments.

COMMERCIAL FISH LANDINGS IN CALIFORNIA BY FISHING BOATS

January, 1940

Compiled by the Division of Fish and Game, Bureau of Marine Fisheries

Species	California waters								Waters south international boundary		Total landings by fishing boats
	*Del Norte and Eureka Region	Sacramento Region	San Francisco Region	Monterey Region	Santa Barbara Region	Los Angeles Region	San Diego Region	Total pounds	Los Angeles Region	San Diego Region	
Anchovy						532,804		532,804			532,804
Barracuda						1,123	89,737	90,860	167,613	29,792	288,265
Cabezone			35					35			35
Cabrilla									9,781		9,781
Carp		364						364			364
Catfish		7,215						7,215			7,215
Cultus, Pacific	6,189		2,070	3,798			70	12,136			12,136
Flounder, Starry	150		35,097	1,048				36,295			36,295
Grouper									4,829	499	5,328
Hake	230							230			230
Halibut, California			1,516	3,278	48,730	30,308	14,514	98,346			98,346
Hardhead		24						24			24
Herring, Pacific	23,610		224,325					247,935			247,935
Kingfish			1,770	5,683		18,024	111	26,494			26,494
Mackerel, Horse				1,230		28,878		30,108			30,108
Mackerel, Pacific				88,512	1,304	15,010,458	524,105	15,624,379			15,624,379
Mackerel, Spanish									150		150
Perch	230		1,447	28	8	1,791		3,504			3,504
Pike		12						12			12
Pompano, California						2,292		2,292			2,292
Rock Bass					3,783	3,775	4,166	11,694	798	95	12,587
Rockfish	12,057		33,288	131,455	31,972	22,145	9,505	241,322		4,817	246,139
Sablefish	6,987		6,995	757		3,799		18,538			18,538
Salmon		26,595				7		26,602			26,602
Sand Dab	225		53,189	184		101		53,699			53,699
Sardine		3,897,500	4,529,800	60,101,615		52,307,290	19,110	120,855,654			120,855,654
Sculpin						2,927	4,692	7,619			7,619
Sea-bass, Black				287	915	525	504	2,231	15,798	1,059	19,088
Sea-bass, White				224	31,529	1,253	1,154	37,160	147	1,317	38,624
Shark	11,424	109,757	317,891	202,100	21,674	4,227	1,561	758,694			758,694
Sheepshead					8,420	1,692	35	10,147	650	461	11,258
Skate	300		33,786	2,079	6,476	408	80	43,129			43,129
Smelt	64		18,292	2,618	368	18,176	1,702	41,220			41,220
Sole	48,433		662,222	1,961	6,613	214	68	719,511			719,511
Split-tail		406						406			406

Sucker		14						14			14
Tomcod			488					488			488
Tuna, Bluefin						56,292		56,292		575	56,867
Tuna, Bonito				3,510	203	71,803	210,201	294,717	1,052	26,520	323,189
Tuna, Skipjack									151,037	410,894	561,931
Tuna, Yellowfin									817,498	7,769,238	8,586,736
Turbot			1,477	129		10		1,607			1,607
Whitebait	11,003		1,321					13,227			13,227
Whitefish, Ocean					8,588	1,675		10,263	705	1,082	12,050
Yellowtail						12	19,245	19,257	11,338	75,529	106,124
Miscellaneous Fish	1,155		7,736	11	209	1,271	79	10,461		195	10,656
Crustacean:											
Crab	128,882		211,822	4,008				344,712			344,712
Crab, Rock						762		762			762
Lobster, Spiny					5,822	8,418	1,350	15,609	8,783	216,237	240,629
Shrimp			20,831	68				20,899			20,899
Mollusk:											
Abalone					21,150			21,150			21,150
Clam, Cockle			10			1,125		1,141			1,144
Clam, Gaper			236					236			236
Clam, Pismo				1,380	10,823			12,203			12,203
Clam, Soft-shell	87		4,037					4,124			4,124
Clam, Washington	2,341		228					2,569			2,569
Octopus	77		173	58		48		358			358
Oyster, Eastern			10,528					10,528			10,528
Oyster, Japanese			120,442					120,442			120,442
Oyster, Native	2,320		60					2,380			2,380
Squid							2,396	2,396			2,396
Total pounds	257,564	1,131,887	6,801,141	60,556,102	208,589	68,131,539	916,695	140,303,488	1,201,103	8,568,880	150,330,477

* The geographical regions of the State are as follows:
Del Norte and Eureka Region: Del Norte, Humboldt and Mendocino counties.
Sacramento Region: Sacramento and San Joaquin river systems with the delta areas, including Suisun Bay and Lake County.
San Francisco Region: Sonoma, Marin, San Francisco and San Mateo counties, including San Francisco and San Pablo bays.
Monterey Region: Santa Cruz and Monterey counties.
Santa Barbara Region: San Luis Obispo, Santa Barbara and Ventura counties.
Los Angeles Region: Los Angeles and Orange counties.
San Diego Region: San Diego and Imperial counties.
These tables are subject to slight revision due to belated supplemental items.

COMMERCIAL FISH LANDINGS IN CALIFORNIA BY FISHING BOATS

February, 1940

Compiled by the Division of Fish and Game, Bureau of Marine Fisheries

Species	California waters								Waters south international boundary		Total landings by fishing boats
	*Del Norte and Eureka Region	Sacramento Region	San Francisco Region	Monterey Region	Santa Barbara Region	Los Angeles Region	San Diego Region	Total pounds	Los Angeles Region	San Diego Region	
Anchovy						346,227		346,227			346,227
Barracuda						1,071	4,547	5,618	147,613	950	154,181
Cabezone			93	8				101			101
Cabrilla										22,479	22,479
Carp		1,362						1,362			1,362
Catfish		7,725						7,725			7,725
Cultus, Pacific	18,547		13,232	1,699		74		33,552			33,552
Flounder, Starry	6,841		90,910	158				97,909			97,909
Grouper										3,745	3,745
Halibut, California			7,996	2,247	30,024	54,702	35,452	130,421			130,421
Hardhead		53						53			53
Herring, Pacific	10,289		155,305	120				165,714			165,714
Kingfish			3,105	10,999	40	21,735		35,879			35,879
Mackerel, Horse				393		13,712		14,105			14,105
Mackerel, Pacific				59,891	405	9,647,075	18,326	9,725,700			9,725,700
Perch			4,227	26	39	2,571		6,863			6,863
Pompano, California						868		868			868
Rock Bass					7,152	1,665	1,758	10,575		871	11,446
Rockfish	43,596		35,451	157,513	31,762	32,016	21,209	324,538		16,147	340,685
Sablefish	3,282		1,693	1,628		2,793		9,396			9,396
Salmon		31,006	13,570					44,576			44,576
Sand Dab	6,158		43,177	3,114		1,378		53,827			53,827
Sardine		3,308,000	5,482,500	35,877,963		29,537,664	1,205	74,207,332			74,207,332
Sculpin						4,390	2,444	6,834			6,834
Sea-bass, Black				76	549	1,002	98	1,725		6,774	8,499
Sea-bass, White				610	14,026	626	1,458	16,720	419	798	17,937
Shad		450						450			450
Shark	8,564	130,768	223,980	86,521	17,662	4,314	2,601	474,410			474,410
Sheepshead					9,621	569		10,190		400	10,590
Skate	1,590		24,872	641	4,508	529	312	32,452			32,452
Smelt	114		20,118	1,650	292	13,032	1,980	38,086			38,086
Sole	243,498		307,883	2,273	8,731	822	105	563,312			563,312
Split-tail		678						678			678
Sucker		12						12			12
Tomcod			481					481			481

Tuna, Bluefin						48,993		48,993		886	49,879
Tuna, Bonito						15,077	101,976	117,053		18,631	135,684
Tuna, Skipjack									169,933	372,498	542,431
Tuna, Yellowfin									883,744	4,376,596	5,260,340
Turbot			2,080	170				3,150			3,150
Whitebait	16,758		659					17,417			17,417
Whitefish, Ocean					7,116	370		7,486		1,460	8,976
Yellowtail							3,274	3,274	13	95,925	99,212
Miscellaneous Fish	5,320		9,499		261	405		15,485			15,485
Crustacean:											
Crab	116,590		330,384	5,710				461,984			461,984
Crab, Rock						334		334			334
Lobster, Spiny					4,509	6,568	1,651	12,748	16,958	172,216	201,922
Shrimp			30,744					30,744			30,744
Mollusk:											
Clam, Cockle			35			2,579		2,614			2,614
Clam, Gaper			400					400			400
Clam, Pismo				1,941	10,958			12,899			12,899
Clam, Soft-shell	69		3,942					4,011			4,011
Clam, Washington	2,309		367					2,676			2,676
Mussel				100				100			100
Octopus	93		222	280	48	19		662			662
Oyster, Eastern			11,636					11,636			11,636
Oyster, Japanese			120,471					120,471			120,471
Oyster, Native	1,680							1,680			1,680
Squid				30		16,417	4,324	50,771			50,771
Total pounds	485,598	3,480,054	6,960,932	36,215,731	147,703	39,810,487	202,741	87,303,249	1,224,680	5,090,405	93,618,335

* See footnote to table for January.

COMMERCIAL FISH LANDINGS IN CALIFORNIA BY FISHING BOATS

March, 1940

Compiled by the Division of Fish and Game, Bureau of Marine Fisheries

Species	California waters								Oregon and Washington waters	Waters south international boundary		Total landings by fishing boats
	*Del Norte and Eureka Region	Sacramento Region	San Francisco Region	Monterey Region	Santa Barbara Region	Los Angeles Region	San Diego Region	Total pounds	Del Norte and Eureka Region	Los Angeles Region	San Diego Region	
Anchovy			1,000			118,668		119,668				119,668
Barracuda					11,310	182,950	110,781	305,041		72,425		377,466
Cabezone			698	81				779				779
Cabrilla										7,415	2,076	9,491
Carp		4,273						4,273				4,273
Catfish		26,862						26,862				26,862
Cultus, Pacific	35,591		32,352	2,972	15	23	45	70,998	200			71,198
Flounder, Starry	10,095		119,423	1,257	65			130,840				130,840
Flying Fish						607		607				607
Grouper										618	5,150	5,768
Hake			95					95				95
Halibut, California			11,446	919	32,000	65,352	18,097	128,714			10,170	138,884
Halibut, Northern					30			30				30
Hardhead		21						21				21
Herring, Pacific			15,126		200			15,326				15,326
Kingfish			4,581	8,315	100	37,829	52	50,877				50,877
Mackerel, Horse				534	45	24,693		25,272				25,272
Mackerel, Pacific				51,326	498	3,599,870	13,890	3,965,584				3,965,584
Mackerel, Spanish										1,759		1,759
Perch	365		7,117	458	27	4,308		12,305			355	12,660
Pike		33						33				33
Pompano, California				4		1,543		1,547				1,547
Rock Bass			114		15,154	7,958	1,205	24,432			234	24,666
Rockfish	68,908		70,706	203,377	51,592	78,843	36,978	510,491	550		15,278	532,322
Sablefish	6,425		917	1,801		6,379		15,525				15,525
Salmon		45,537	12,970	6,949				65,456				65,456
Sand Dab	24,961		27,309	4,621		1,333		58,314	1,150			59,464
Sardine			21,400	69,053	3,745	18,148,436	1,193	18,243,827				18,243,827
Sculpin						7,473	4,232	11,705				11,705
Sea-bass, Black					948	919	237	2,101		1,356	1,293	4,753
Sea-bass, White			13	35	7,105	12,248	2,024	21,425		1,085	72	22,582
Shad		77,150						77,150				77,150
Shark	506	9,423	43,185	1,781	22,256	11,617	4,934	93,702			411	94,113
Sheepshead					8,858	3,761	35	12,654			205	12,862

Skate	1,990		14,095	1,078	7,561	1,438		26,165				26,165
Smelt	1,479		11,202	1,445	2,555	13,805	1,599	32,086				32,086
Sole	370,825		157,695	13,989	9,973	1,314	914	554,710	17,475			572,215
Split-tail		236						236				236
Sucker		75						75				75
Tomcod			386					386				386
Tuna, Bluefin										179,846		179,846
Tuna, Bonito					16	51,528	38,199	92,743		9,354	857	102,954
Tuna, Skipjack										1,461,876	410,608	1,875,484
Tuna, Yellowfin										1,292,348	6,619,945	7,912,293
Turbot			1,225	205		44		4,474				4,474
Whitebait	22,644		1,357	23				24,022				24,022
Whitefish, Ocean					6,431	2,670	25	9,135			240	9,375
Yellowtail						2,747	57,019	59,766		13,433	18,641	91,870
Miscellaneous Fish	12,030		4,552	232	385	1,697	12	18,878	409		400	19,678
Crustacean:												
Crab	188,011		363,264	4,730				556,008	816			556,824
Crab, Rock						392		392				392
Lobster, Spiny					4,387	2,636	520	7,543		14,580	105,308	128,431
Shrimp			47,279					47,279				47,279
Mollusk:												
Abalone				78,150	83,450			161,600				161,600
Clam, Cockle			32			2,765		2,797				2,797
Clam, Gaper			292					292				292
Clam, Pismo				2,354	14,565			16,919				16,919
Clam, Soft-shell			4,280					4,280				4,280
Clam, Washington	2,685		275					2,960				2,960
Octopus	380		570	650				1,592				1,592
Oyster, Eastern			11,982					11,982				11,982
Oyster, Japanese			108,786					108,786				108,786
Oyster, Native	2,240		230					2,470				2,470
Squid				25,710		810		26,520				26,520
Total pounds	749,228	163,610	1,099,061	488,055	284,174	22,699,636	292,052	25,775,816	20,501	3,059,035	7,192,240	36,047,748

* See footnote to table for January.

88400 9-40 3800

BUREAU OF ENGINEERING

JOHN SPENCER, Chief San Francisco
Clarence Elliger, Assistant Hydraulic Engineer San Francisco
Byron Wittorff, Assistant Red Bluff
Edward Hensley, Junior Engineering Aid Siskiyou County
Samuel Kabakov, Junior Engineering Aid San Francisco
Emmert Lippincott, Junior Engineering Aid Siskiyou County

BUREAU OF LICENSES

H. R. DUNBAR, Chief Sacramento
L. O'Leary, License Agent Sacramento
O. Coleman, License Agent San Francisco
R. Nickerson, License Agent Los Angeles

BUREAU OF PATROL

E. L. MACAULAY, Chief of Patrol San Francisco

CENTRAL DISTRICT (Headquarters, Sacramento)

LaRue Chappell, Inspector in Charge Sacramento

Northern Division

A. A. Jordan, Captain Redding
Jos. H. Sanders, Captain Sacramento
A. H. Willard, Captain Nevada City
E. O. Wraith, Captain Susanville
L. E. Mercer, Warden, Butte County Chico
Taylor London, Warden, Colusa County Colusa
Albert Sears, Warden, El Dorado County Placerville
E. C. Vail, Warden, Glenn County Willows
Don Davison, Warden, Modoc County Alturas
Earl Hiscox, Warden, Nevada County Nevada City
Wm. La Marr, Warden, Placer County Tahoe City
Nelson Poole, Warden, Placer County Auburn
E. J. Johnson, Warden, Plumas County Quincy
J. W. Thornburg, Warden, Plumas County Chester
H. S. Vary, Warden, Sacramento County Sacramento
Eugene Durney, Assistant Warden, Sacramento County Sacramento
Earl Caldwell, Warden, Shasta County Burney
Chas. Love, Warden, Shasta County Redding
Don Chipman, Warden, Siskiyou County Dunsmuir
Brice Hammack, Warden, Siskiyou County Yreka
Fred R. Starr, Warden, Siskiyou County Dorris
R. E. Tutt, Warden, Sierra County Downieville
J. E. Hughes, Warden, Solano County Fairfield
A. Granstrom, Warden, Sutter County Yuba City
R. W. Anderson, Warden, Tehama County Red Bluff
C. L. Gourley, Warden, Trinity County Weaverville
C. O. Fisher, Warden, Yolo County Woodland
R. A. Tinnin, Warden, Yuba County Browns Valley

Southern Division

S. R. Gilloon, Captain Fresno
John O'Connell, Captain Stockton
R. J. Little, Warden, Amador County Pine Grove
L. R. Garrett, Warden, Calaveras County Murphys
F. A. Bullard, Warden, Fresno County Reedley
Paul Kehrer, Warden, Fresno County Fresno
Lester Arnold, Warden, Kern County Bakersfield
C. S. Donham, Warden, Kern County Kernville
Ray Ellis, Warden, Kings County Hanford
H. E. Black, Warden, Madera County Madera
Gilbert T. Davis, Warden, Mariposa County Mariposa
M. S. Clark, Warden, Merced County Merced
R. J. Bullard, Warden, San Joaquin County Tracy
Wm. Hoppe, Warden, San Joaquin County Lodi
Geo. Magladry, Warden, Stanislaus County Modesto
W. I. Long, Warden, Tulare County Visalia
Roswell Welch, Warden, Tulare County Porterville
F. F. Johnston, Warden, Tuolumne County Sonora

COAST DISTRICT (Headquarters, San Francisco)

K. P. Allred, Inspector in Charge San Francisco

Northern Division

W. J. Harp, Captain Ukiah
J. D. Dondero, Captain Lakeport
Henry Lencioni, Captain Santa Rosa
Ray Diamond, Warden, Del Norte County Crescent City
John Hurley, Warden, Humboldt County Eureka
W. F. Kallher, Warden, Humboldt County Fortuna
Scott Feland, Warden, Lake County Lakeport
R. J. Yates, Warden, Marin County San Rafael
Ovid Holmes, Warden, Mendocino County Fort Bragg
Leo Mitchell, Warden, Mendocino County Point Arena
R. Remley, Warden, Mendocino County Willits
J. W. Harbuck, Warden, Napa County Napa
Bert Laws, Warden, Sonoma County Petaluma
Victor Von Arx, Warden, Sonoma County Santa Rosa
George Johnson, Warden, Sonoma County Cloverdale

Southern Division

O. P. Brownlow, Captain Alameda
C. L. Bundock, Warden, Alameda County Oakland
Ed Clements, Warden, Contra Costa County Martinez
Owen Mello, Warden, Monterey County Pacific Grove
Orben Philbrick, Warden, Monterey County King City
F. H. Post, Warden, Monterey County Salinas
J. P. Vissiere, Warden, San Benito County Hollister
Lee C. Shea, Warden, San Francisco County San Francisco
F. W. Hecker, Warden, San Luis Obispo County San Luis Obispo
C. R. Peek, Warden, San Mateo County San Mateo
C. E. Holladay, Warden, Santa Clara County San Jose
F. J. McDermott, Warden, Santa Cruz County Santa Cruz

SOUTHERN DISTRICT (Headquarters, Los Angeles)

C. S. Bauder, Inspector in Charge Los Angeles
E. H. Ober, Captain, Special Duty Los Angeles

Western Division

Earl Macklin, Captain Summerland
L. T. Ward, Captain Escondido
Fred Albrecht, Warden, Los Angeles County Los Angeles
Walter Emerick, Warden, Los Angeles County Palmdale
Theodore Jolley, Warden, Los Angeles County Los Angeles
E. H. Glidden, Warden, San Diego County San Diego
Walter Shannon, Warden, San Diego County Julian
A. R. Ainsworth, Warden, Santa Barbara County Santa Maria
R. E. Bedwell, Warden, Santa Barbara County Santa Barbara
John Spicer, Warden, Ventura County Ojai

Eastern Division

H. C. Jackson, Captain San Bernardino
W. S. Talbott, Warden, Inyo County Bishop
C. J. Walters, Warden, Inyo County Independence
Al Crocker, Warden, Mono County Bridgeport
Charles Mayfield, Warden, Orange County Oranga
W. C. Blewett, Warden, Riverside County Indio
W. L. Hare, Warden, Riverside County Hemet
R. C. O'Conner, Warden, Riverside County Banning
A. L. Stager, Warden, San Bernardino County Upland
W. C. Malone, Warden, San Bernardino County San Bernardino
James Loundagin, Warden, San Bernardino County Big Bear Lake

MARINE PATROL

C. H. Groat, Inspector in Charge—Terminal Island
Ralph Classic, Captain—Monterey
Lars Weseth, Master, M. V. *N. B. Scofield*—Terminal Island
Walter Engelke, Master, M. V. *Bluefin*—Terminal Island
Howard V. Shebley, Warden, Cruiser *Bonito*—Santa Barbara
John Barry, Assistant Warden, Cruiser *Bonito*—Santa Barbara
_____, Warden, Cruiser *Broadbill*—San Diego
Kenneth Webb, Assistant Warden, Cruiser *Broadbill*—San Diego
Donald Glass, Warden, Cruiser *Marlin*—Santa Monica
Niles Millen, Assistant Warden, Cruiser *Marlin*—Santa Monica
Charles Sibeck, Warden, Launch *Perch*—Sacramento
L. M. Booth, Assistant Warden, Launch *Perch*—Sacramento
Kenneth Hooker, Warden, Cruiser *Quinnat III*—San Francisco
Richard Hardin, Assistant Warden, Cruiser *Quinnat III*—San Francisco
K. Lund, Assistant Warden, Launch *Sturgeon*—Martinez
Carmi Savage, Warden, Cruiser *Tuna*—Avalon
M. G. Stowart, Assistant Warden, Cruiser *Tuna*—Avalon
E. R. Hyde, Warden, Cruiser *Yellowtail*—Balboa
L. R. Metzgar, Assistant Warden, Cruiser *Yellowtail*—Balboa
W. J. Black, Warden—Monterey
Erol Greenleaf, Warden—Terminal Island
Lester Golden, Warden—Arroyo Grande
N. C. Kunkel, Warden—Terminal Island
Leslie E. Lahr, Warden—Eureka
Ralph Miller, Warden—San Francisco
Tate F. Miller, Warden—Terminal Island
T. W. Schilling, Warden—Terminal Island
G. R. Smalley, Warden—Richmond
T. J. Smith, Warden—San Diego
L. G. Van Vorhis, Warden—Terminal Island
E. L. Walker, Warden—Terminal Island
J. R. Cox, Assistant Warden—Watsonville
Frank Felton, Assistant Warden—San Diego

POLLUTION DETAIL

Paul Shaw, Chemist in Charge—San Francisco
C. L. Towers, Warden—Los Angeles
Jack McKerlie, Warden—Oakland
R. Schoen, Warden—Terminal Island
Clarence Whaley, Assistant Warden—Long Beach
Don Hall, Assistant Warden—Santa Barbara
J. A. Reutgen, Assistant Warden—Santa Barbara
Harold Lantis, Assistant Warden—Redding

CALIFORNIA JUNIOR GAME PATROL

M. F. Joy, Warden, Superintendent Junior Game Patrol—San Francisco
Geo. D. Seymour, Assistant, Junior Game Patrol—San Francisco

MARINE PATROL AND RESEARCH

Motor Vessel *N. B. Scofield,* Terminal Island

Motor Vessel *Bluefin,* Terminal Island

Cruiser *Yellowtail,* Newport Harbor

Cruiser *Broadbill,* San Diego

Cruiser *Quinnat III,* San Francisco

Cruiser *Bonito,* Santa Barbara

Cruiser *Marlin,* Santa Monica

Cruiser *Tuna,* Avalon

Launch *Shrapnel,* Lakeport

Launch *Sturgeon,* Martinez

Launch *Perch,* Sacramento

printed in CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1940 GEORGE H. MOORE, STATE PRINTER